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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

In this issue of the ELECTRICAL REVIEW there is begun the publication of a series of reviews of current engineering and scientific literature which, it is hoped, will become an appreciated feature of this journal. In the great mass of literature, dealing either with electricity and its applications or with the allied field of engineering and scientific development, there is constantly coming up much matter of the deepest interest. It is the purpose of this new department to review this as succinctly as may be possible and to give each week a current review that will keep the reader in touch with the general progress of the world, in the development of engineering of whatever kind and of scientific advance.

THE DIRECTION OF PHYSICAL RESEARCH.

In regarding the work now being done in physical research throughout the world, one can not fail to be struck by the amount of labor that is at present being given to those branches of physics dealing with the phenomena lying in the border land between electrical physics and chemistry. Within the last decade the brilliant researches of Ostwald and Van't Hoff upon ionic condition in solutions and the astonishing phenomena discovered by J. J. Thomson concerning the movement of ions in attenuated gases, together with the extraordinary discoveries of Rœntgen and Becquerel, have given an entirely new direction of advance to physical research.

Out of all this study of the infinitely little results of the utmost magnitude may be expected to arise. The entire new industrial application of electrochemistry, particularly as regards the synthesis of compounds, has largely arisen from the research work of that splendid group of European investigators of which Professor Van't Hoff is the leader. But perhaps more important than any immediate industrial application is the immense enlargement of the mental horizon of the electrician due to the results which have flowed already from the researches of Thomson and Zeeman. We are coming, slowly perhaps, but very surely, closer to a definite understanding of the mechanism of matter. The riddle of the universe appears to be in process of solution and we may look forward with some complacency to the time when we shall at least know more than we do now about the constitution of matter, the nature of the ether and the interrelation of force and these entities. The whole condition of our present knowledge and of the present advance in it points definitely to some new and great generalization, which shall advance scientific knowledge, perhaps, as much as did Darwin's conception of organic evolution or the splendid work of Maxwell in correlating and ordinating the work of Faraday and his predecessors. We seem to stand upon the threshold of advance; the inner mysteries of nature seem on the point of being opened for us.

It is curious again to note how nearly all of physics and chemistry has come to be regarded as electrical. This has even gone so far that the search, protracted through many years of the last century, to discover a mechanical explanation of electricity and its action has been almost transferred into a research for the electrical explanation of mechanics. Already tentative theories have been timidly advanced looking to the suggestion that mass, that apparently cardinal attribute of matter, is after all an electrical phenomena and that even gravitation may fall measurably within the category of electrical manifestations. Perhaps by this substitution of one mystery for another we have not advanced so far as we might naturally be led to think; but no insight that can be gained into the working of natural forces or into the processes of nature is unavailing. With every addition to our knowledge we come closer to the great and final generalization which shall open for us the door to the inner sanctum of the universe.

It is true that we can not yet define what electricity is, nor, for that matter, can we define anything in absolute terms. We do not yet know even what is the nature of matter or of force or of the all-surrounding ether. But every new step that is not founded upon a false conception leads us inevitably nearer to the truth, and nearer to that final understanding which no man of science can fail to feel is the ultimate heritage of the race. The older idea that nature itself was an insoluble problem and that the mystery of the universe was one that no man could ever unfold is passing away, and recent research has done much to show that we may hope in the end to know the real and

ultimate reasons of things—the actual logic of cause and effect.

Toward these solutions the new science seems inevitably to tend. Already the atomic theory of Dalton, the foundation of what has been regarded as chemical science, is shaking and a new light has been cast upon some of the most difficult and obscure regions of chemical and physical action.

A POSSIBLE CONSOLIDATION.

For many years past those who have noted the progress of the various great corporations engaged in the business of transmitting intelligence by electrical means have wondered why no combination was formed, to secure the enormously great advantage of economy of operation that could be had were the telephone and telegraph plants put under one management. Of late there has been a movement which has led to the belief in more than one quarter that such a consolidation is possible, if not inevitable.

When various circumstances of common knowledge are taken into account, such for example as the formation of the Western Telephone and Telegraph Company, the apparent tendency to gather together the various subordinate interests working under the general control of the American Telephone and Telegraph Company, and recent changes in the directorate of that concern, the trend of affairs is more than evident.

When it is considered that there are now two great telegraph companies and one powerful telephone corporation with centralized interests in simultaneous operation over the same territory, and all of them maintaining extensive and complicated networks of conductors, each of them having offices in thousands of places, the immense possible economies of consolidation are immediately apparent. The formation of the Western Telephone and Telegraph Company and numerous changes that have taken place in the personnel of the licencee Bell companies have at least suggested a possible desire to amalgamate all of the Bell interests in one or more strong operating companies. The addition to the board of directors of the American Telephone and Telegraph Company of men affiliated with telegraph interests, and of great financial strength —largely interested in Western Union and Postal stocks—is another pointer which indicates the general direction of this movement.

This is unquestionably an era of consolidations and of the formation of gigantic corporate bodies of great power. The condition of the business of intelligence transmission is such as to point, perhaps inevitably, to such a consolidation as has been hinted at. That it will be formed no student of current commercial conditions in this country can seriously doubt. That its effect in general will be beneficial, alike to the companies and to the public, is also open to no doubt. What effect this will have upon the already large and constantly growing independent telephone interests is hard to foresee, but there seems no reason why, in the general amalgamation of telegraph and telephone corporations, there should not be found room for such of the independent companies as have proved their title to existence. At any rate further destructive competition in this direction may now be looked upon as an industrial error and, following the example already set by the welding together of the steel interests and by the formation of powerful holding companies to secure, in a legal way, the merger of competing railway interests, it certainly is not looking too far to foresee the ultimate and perhaps inevitable consolidation of all of the now competing and warring corporations conducting the vast enterprise of transmitting intelligence from place to place in the United States. The result would certainly be increased facilities, improved services and a reduction of rates to the general public.

THE INSTITUTE MEETING.

The subject for discussion at the last meeting of the Institute of Electrical Engineers, which is reported fully elsewhere in this issue, was "Telephony," and the two papers presented both dealt with the business or operative side of this industry rather than with any engineering feature connected with it. By those who have watched the progress of the Institute with that interest born of a belief in its value to science and engineering in this country, the introduction of such subjects for discussion can not be viewed with satisfaction.

As soon as an engineering society begins to admit for discussion papers bearing upon the commercial side of engineering development, just so soon does it invite dissension and lower its tone to the level of a commercial society. It is not for a moment to be thought that the associations and societies formed for the discussion of commercial, semi-commercial and commercial-engineering problems are not of the deepest importance and greatest value, for they are. But the Institute represents electrical engineering and science almost officially in this country, and it is unfortunate to see the beginning of discussions of a commercial character at its meetings.

The telephone, of all branches of electrical engineering, has the least literature and probably presents the most attractive field for the writing of articles and papers. The average general electrical engineer is very little acquainted with telephone phenomena and they form practically a new and unknown field, lying outside of the experience of the majority of members of the Institute. It ought not to be impossible to secure a number of papers of high value and importance dealing purely with the engineering side of the telephone. At any rate, discussion of the telephone should be confined, in this particular society, to its technical and scientific features.

Not the least of the benefits that electricity has conferred on the public in general is the betterment of lighting, ventilation, transport and heating in hospitals and sick-rooms. On other pages of this number is described the equipment of a magnificent model hospital lately erected in New York city. It will be noticed that nearly all of the work of ventilating, lighting, heating and transportation connected with the institution is done electrically. Patients are enabled to enjoy the utmost excellence of sanitary surroundings, while much of the harder work of their care is accomplished by the judicious use of electric power.

THE OPERATION OF TWO OR MORE DYNAMOS TOGETHER.

BY B. T. McCORMICK.

The management of dynamos working together is, with many engineers, merely mechanical, as they either have a very hazy idea of the principles involved, or else are totally ignorant of them.

The object of this article is to furnish the electrician with the reasons for doing some of the things which he has done heretofore simply because he was told by some one who knows more than he.

Three cases will be discussed—dynamos in parallel, the three-wire system and dynamos in series. As will be seen, they are all modifications of one general case.

In the first place, if we have a circuit, as shown in Fig. 1, we can find the current between A and B by either of the following formulas:

$$I = \frac{Pd}{R}$$

$$I = \frac{E - Pd}{r}$$

where I stands for current, Pd for the difference of potential between A and B, R for external resistance, r for internal resistance and E for the electro-motive force of the cell.

GENERAL CASE.

Passing now to the general case (see Fig. 2) we will suppose that all electro-motive forces and potential differences tending to make current flow from A to B are positive.

The current flowing in the middle branch is:

$$I = I_1 + I_2. \qquad (1)$$

But we know that from what has previously been said that:

$$I_1 = \frac{E - Pd}{R_1 + r} \qquad (2)$$

$$I_2 = \frac{E_1 - Pd}{R_2 + r_1} \qquad (3)$$

$$I = \frac{Pd}{R} \qquad (4)$$

where Pd is the difference of potential between A and B. Substituting in (1) gives:

$$\frac{Pd}{R} = \frac{E - Pd}{R_1 + r} + \frac{E_1 - Pd}{R_2 + r_1}$$

We now solve for Pd which is as yet unknown.

$$\frac{Pd}{R} = \frac{E}{R_1 + r} - \frac{Pd}{R_1 + r} + \frac{E_1}{R_2 + R_1} - \frac{Pd}{R_2 + r_1}$$

$$Pd\left(\frac{1}{R} + \frac{1}{R_1 + r} + \frac{1}{R_2 + r_1}\right) =$$

$$\frac{E}{R_1 + r} + \frac{E_1}{R_2 + r_1}$$

$$Pd = \frac{\dfrac{E}{R_1 + r} + \dfrac{E_1}{R_2 + r_1}}{\dfrac{1}{R} + \dfrac{1}{R_1 + r} + \dfrac{1}{R_2 + r_1}} =$$

$$\frac{\dfrac{E}{R_1 + r} + \dfrac{E}{R_2 + r_1}}{\dfrac{(R_1 + r)(R_2 + r_1) + R(R_2 + r_1) + R(R_1 + r)}{R(R_1 + r)(R_2 + r_1)}}$$

$$= \frac{\dfrac{E}{R_1 + r} + \dfrac{E_1}{R_2 + r_1}\,[R(R_1 + r)(R_2 + r_1)]}{(R_1 + r)(R_2 + r_1) + R(R_2 + r_1) + R(R_1 + r)}$$

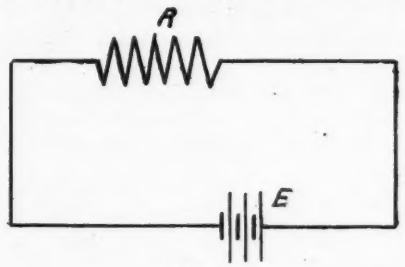


FIG. 1.

$$Pd = \frac{R\,[E\,(R_2 + r_1) + E_1\,(R_1 + r)]}{(R_1 + r)(R_2 + r_1) + R(R_2 + r_1) + R(R_1 + r)} \qquad (5)$$

From this we can obtain I, I_1 and I_2 by substituting

$$I_1 = \frac{E - Pd}{R_1 + R} = \frac{E}{R_1 + r} - \frac{R\left[\dfrac{E\,(R_2 + r_1)}{R_1 + r} + E_1\right]}{(R_1 + r)(R_2 + r_1) + R(R_2 + r_1) + R(R_1 + r)} \qquad (6)$$

$$I_2 = \frac{E_1 - Pd}{R_2 + r_1} = \frac{E_1}{R_2 + r_1} - \frac{R\left[\dfrac{E_1\,(R_1 + r)}{R_2 + r_1} + E\right]}{(R_1 + r)(R_2 + r_1) + R(R_2 + r_1) + R(R_1 + r)} \qquad (7)$$

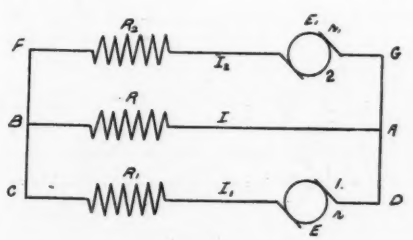


FIG. 2.

$$I = \frac{Pd}{R} = \frac{E\,(R_2 + r_1) + E_1\,(R_1 + r)}{(R_1 + r)(R_2 + r_1) + R(R_2 + r_1) + R(R_1 + r)} \qquad (8)$$

This is the solution for the general case shown in Fig. (2).

MACHINES IN PARALLEL.

Where we have two dynamos working in multiple, the problem reduces to that shown in Fig. 3, where both machines are generating an electro-motive force. The resistances R_1 and R_2 are the resistances of the connecting wires between the switchboard and the machines, and are therefore so small that they may be neglected. For this reason the voltmeters will indicate the difference of potential between A and B which we have called Pd.

Suppose we have machine No. 1 running and wish to throw in No. 2. We start No. 1 and when it attains full speed adjust its rheostat till its voltmeter reads the same as that of No. 2. It is now generating no current except a very small amount consumed by the voltmeter. We now have $E_1 = Pd$, so we switch our machine in. Equation (3) shows that when $E = Pd$ there will be no current flowing, and if we examine ammeter No. 2 we shall find this to be the case. In other words, machine No. 1 is still doing all the work, while No. 2 is generating only enough electro-motive force to prevent No. 1 from sending current through it and running it as a motor. If we now increase the electro-motive force of No. 2 by strengthening its field we shall get a current from No. 2 which will be; see (3)

$$I_2 = \frac{E_1 - Pd}{r_1}$$

By regulating the electro-motive force of the two machines by means of their rheostats we can make each machine contribute whatever current desired to the line. Knowing the maximum current each machine can safely stand, we have a guide as to the regulation of our machines.

Neglecting R_1 and R_2, the equations take the form:

$$Pd = \frac{(E\,r_1 + E_1\,r)\,R}{r\,r_1 + R\,(r + r_1)} \qquad (9)$$

$$I_1 = -\frac{E}{r} - \frac{R\,(E\frac{r_1}{r} + E_1)}{r\,r_1 + R\,(r + r_1)} \qquad (10)$$

$$I_2 = \frac{E_1}{r_1} - \frac{R\left(E_1\dfrac{r}{r_1} + E\right)}{r\,r_1 + R\,(r + r_1)} \qquad (11)$$

$$I = \frac{E\,r_1 + E_1\,r}{r\,r_1 + R\,(r + r_1)} \qquad (12)$$

Whenever the electro-motive force from one of the machines is increased, Pd increases; see (9) so that the current from the other machine decreases. This, however, will do no harm, aside from working one machine harder than the other, unless the current from one machine exceeds the maximum current stipulated on the name-plate of the dynamo or becomes so low that there is danger of its becoming negative; that is, going through the machine backward.

When the machines are alike, as is often

the case, the equations are still more simple, since $r_1 = r$.

$$Pd = \frac{(E + E_1)\,R}{r + 2\,R} \qquad (13)$$

$$I_1 = \frac{E}{r} - \frac{R\,(E_1 + E)}{r^2 + 2\,R\,r} \qquad (14)$$

$$I_2 = \frac{E_1}{r} - \frac{R\,(E_1 + E)}{r^2 + 2\,R\,r} \qquad (15)$$

$$I = \frac{(E_1 + E)}{r + 2\,R} \qquad (16)$$

If we keep the electro-motive force of each machine the same, I_1 will be equal to I_2, and we will have

$$I = \frac{E}{\frac{r}{2} + R} \qquad (17)$$

and the dynamos will do the same amount of work.

EDISON THREE-WIRE SYSTEM.

Fig. 4 shows the connections of the well-known three-wire system.

The resistance R is the resistance of the return central wire and may be neglected for the purpose of illustrating the principles. E_1 will have a minus sign before it, since dynamo 1 tends to send current from B to A. Neglecting R, equations 6, 7 and 8 become

$$I_1 = \frac{-E}{R_1 + r} \qquad (18)$$

$$I_2 = \frac{E_1}{R_2 + r_1} \qquad (19)$$

$$I\,\frac{E_1\,(R_1 + r) - E\,(R_2 + r_1)}{(R_1 + r)\,(R_2 + r_1)} \qquad (20)$$

The current in the return wire is equal to the difference (or algebraic sum) of the currents in each set of lamps. The difference of potential between F and B is $I_2 R_2$ or

$$Pd_2 = \frac{E_1\,R_2}{R_2 + r_1}$$

and between C and B,

$$Pd_1 = \frac{-E\,R_1}{R_1 + r}$$

As long as Pd_1 and Pd_2 are kept equal and of the proper value, each lamp will get the proper current. This can be regulated by changing E and E_1. Each side of the system is operated independently of the other just as if they had no connection at all.

DYNAMOS IN SERIES.

When the central wire is absent or when R = infinity, we have the simple case of dynamos in series. Dividing equation (6) by R and then putting $R = \infty$ gives, when E is minus:

$$I_1 = \frac{-E}{R_1 + r} - \frac{-E\,(R_2 + r_1)}{R_1 + r} + E_1$$
$$(R_2 + r_1) + (R_1 + r)$$

Clearing of fractions,

$$I_1 = \frac{-E(R_2 + r_1) - E(R_1 + r) + E(R_2 + r_1) - E_1(R_1 + r)}{(R_1 + r)\,[(R_2 + r_1) + (R_1 + r)]}$$

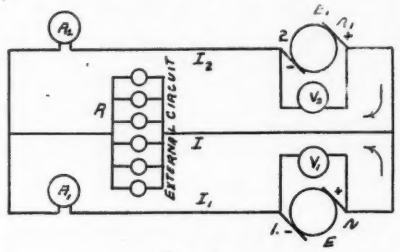


FIG. 3.

$$I_1 = -\frac{E}{R_1 + R_2 + r_1 + r}$$

and equation (7) will give the same result for I_2. Equation (8) shows that I will be zero when the central wire is absent and R = infinity.

A dynamo should be started before switching into series, so that the machines which are already at work will not drive it as a motor.

Balloons in Wartime.

A very interesting paper on "The Use of Balloons in War," was read before the Society of Arts recently by Mr. Eric H. Stuart Bruce. After some prefatory remarks as to the earlier use of balloons in wartime, the author turned his attention to the material out of which the balloon should be constructed. For this purpose he favored goldbeaters' skin. The reduction in the size of the war balloons was a very important matter. By the use

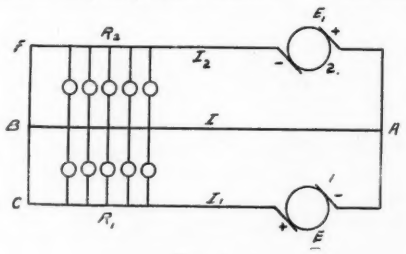


FIG. 4.

of goldbeaters' skin, not only was the size of the balloon reduced, but also the weight of the equipment, when cylinders of compressed gas were taken out to the field of operations, for filling the balloons. At first sight the material might seem too fragile, but the desideratum of strength was obtained by combining layers on layers of the substance to any desired thickness. The author then gave an example of the extreme value of balloons in war, taking the siege of Ladysmith for an illustration. From this elevated position the captive balloon used at that time could locate the Boer guns, and by despatching telephonic messages to earth ensure the accuracy of the artillery fire from the British force. The translucent South African atmosphere peculiarly lent itself to balloon observations; thus, in manœuvres in England the range of a balloon's effective vision at a height of 1,000 feet was not more than seven or eight miles, whereas in South Africa it was ten or twelve miles. Mr. Bruce next related how some few years ago he applied electric flash signaling to a captive balloon so that the operator might remain on the ground. In this system—which is too well known to call for a detailed description here—since the weight of the car and operator was abolished, the balloon could be of such a size as to be portable, quickly inflated and easily manipulated. A specially portable form of signaling balloon was the emergency balloon. To obtain lightness in this balloon the author employed goldbeaters' skin instead of varnished cambric, with the material of which only larger signaling balloons were made. Mobility was also secured by improvements in the electric storage batteries used, which were thereby rendered very portable. He estimated that the smallest possible size for an emergency electric signaling balloon to be useful would be seven feet in diameter. This would lift a light cable and the lamps a few hundred feet, and only require one gas cylinder of 120 cubic feet capacity for its inflation. In referring to the question of wind forces, the author stated that in the Santos Dumont experiments the wind forces overcome amounted to about 4½ m. to 5 m. per second, an advance of 1½ m. per second on the experiments of Captains Krebs and Renard in 1885. To further the solution of the problem of a navigable balloon capable of being useful in war, he thought careful quantitative experiments would be more useful than any number of the more sensational journeys under the conditions of money prizes, in which the scientific desiderata were not sufficiently taken into account. A discussion followed the reading of the paper, in his reply to which Mr. Bruce admitted that linseed oil was almost useless for treating balloons; a good varnish the great thing needed.—*Electrical Engineer* (London).

The German ministers of War and Agriculture have offered several prizes, 10,000 marks being the highest, for military automobiles using alcohol fuel.

Some Telephone Questions.

Papers and Discussion at the One Hundred and Sixty-Third Meeting of the American Institute of Electrical Engineers.

THE ONE HUNDRED and sixty-third meeting of the American Institute of Electrical Engineers was held in New York, and simultaneously in Chicago, on the evening of Friday, March 28. The subject of the evening's meeting was "Telephony," and two papers were presented by Messrs. A. V. Abbott, of New York, and Franz J. Dommerque, of Chicago, respectively, entitled "The Telephonic Status Quo" and "Telephone Rates from an Engineer's View-Point."

The meeting, which was well attended, was opened by President Steinmetz, who made his usual clear and luminous commentary upon the evening's subject. He said that the subject was really "power transmission," and compared telephony with the long-distance transmission of large powers. In the former, he said, alternating current is used exclusively. He had forgotten just how many millions of years the potential energy of a pound of coal would suffice to make an audible noise in a telephone, but the amount of power concerned in telephony is exceedingly small. Unlike the ordinary transmission line, the telephone line has to work both ways, for both ends of it comprise a generating and receiving station. Owing to the exigencies of the business it is of course necessary to have a switching station or exchange whereby lines may be interconnected as desired. The most characteristic feature of difference between the two kinds or transmission are their purposes and the character of the transmitted power. He spoke of the necessity for using sine waves for power transmission and of the fact that all of the character of sound waves is due practically to their variation from the true sine form. The efficiency of telephone transmission, considered as energy transmission, is exceedingly small but sufficient.

All of the characteristics of any transmission line tend to destroy the higher harmonics of the telephonic wave. As lines grow longer this effect is noticed first by the interference with the quality of tone transmitted, and then with its articulate distinctness. Mr. Steinmetz spoke of the effect of changes of wave shape. He said that telephone generators, or transmitters, work practically as constant-current apparatus. He showed how the capacity effect of long lines tended to absorb the high frequencies of the characteristic harmonics, and showed how this discrimination of the telephone line is the chief difficulty to overcome. He spoke at length of the contrary effects of self-induction and capacity and stated that further improvements must be brought about by apparatus discriminating in favor of the high harmonics. The telephone relay, he said, so far had not proved itself of value. The problem in telephone transmission is not to increase the power transmitted, but to avoid the destruction of wave-shapes and the suppression of high harmonics. For this reason the telephone repeater, if such a thing is ever made, should insert power in proportion to the frequency.

The papers by Messrs. Abbott and Dommerque were then read, Mr. Abbott presenting his own paper, and discussion was opened.

Mr. J. J. Carty, in opening the discussion, took occasion to compliment the committee on papers for having organized a telephone meeting for the first time in the history of the Institute. He remarked that he was glad to know that the Institute had come to appreciate the fact that there were really such things as telephone engineers. Mr. Carty spoke at considerable length of the subject matter of the papers. He made very clear the difficulty that has been felt in making the public understand that there is more to a telephone installation than is evident from the telephone instruments attached to the walls of offices or houses. He had discovered, in the course of several years of employing graduates of engineering colleges, that they too often considered when they had mastered the construction and operation of the Bell receiver and the microphone transmitter they knew the whole science and art of telephony. He took issue with Mr. Steinmetz concerning the statement that the transmitter is a constant-current variety of apparatus. Mr. Carty confined his discussion to matters of engineering interest because, he said, he felt that this meeting was neither the time nor place for the discussion of matters referring to the business policy of telephone companies. He made some facetious reference to the lack of "freedom of speech" of the engineers of his company, referred to in Mr. Abbott's paper, and spoke at some length concerning the difficulty of deciding properly how far data accumulated as the result of given conditions and experiments, carried on at large expense of time and labor, are the property of the employers or of the engineers who make them.

Mr. Carty spoke in detail of the improvement of telephone apparatus in rebuttal of the statement in Mr. Abbott's paper. Prior to 1889, he said, the history of the magneto bell was that of the junk heap. He told the story of the invention or design of the Carty bridging bell, which continued in use in its original form up to 1898. In that year, owing to progress in telephone matters, all of the thousands of these bells, which had been perfected so laboriously and with so much difficulty, were discarded on account of the introduction of the common battery system. Regarding the receiver, he considered it an example of excellent design. The solid-back transmitter had come to be regarded, especially abroad, as practically standard, yet in the last four years his company had taken out and replaced more than fifty thousand of them by a modified type. Mr. Carty spoke briefly of the question of rates and, by a number of ingenious analogies, made it evident what difficulty surrounds this question.

The discussion was continued by Messrs. Abbott, Stott, Thompson, W. J. Hammer and the president.

The following ballot was announced during the meeting as the choice of the board of directors: President, Charles F. Scott; vice-presidents, C. O. Mailloux and S. S. Wheeler; managers, Townsend, Wolcott, G. S. Dunn, E. H. Mullin and Charles A. Terry. Messrs. George A. Hamilton and Ralph W. Pope were renominated for treasurer and secretary, respectively.

TELEPHONE RATES FROM AN ENGINEER'S VIEW-POINT.

BY FRANZ J. DOMMERQUE.

Reviewing the present method of charging for telephone service, it is found that previous to the independent movement, the Bell licencees had a free hand and were in a position to obtain the highest rates. With a competitor in the field, charging lower rates, the old companies had to find some means to meet this competition and to retain at the same time

the old revenues. Three methods of charging for service were introduced besides the old-time flat rate, namely, measured service, pay stations and party-line service. The introduction of these three additional kinds, however, deteriorated the service given to the public. The independent companies did not imitate the Bell in their charges, but kept to the flat rate exclusively, distinguishing, however, between charges for business houses and for residences, thereby not deteriorating service. This seemed fair to all parties concerned, because the amount of work to be performed by an operating company justified a reduction in rates for residences, as the average number of calls per day from a residence subscriber is less than from a business subscriber, and, consequently, the number of operators required for residence service is less than for business service. Experience quickly demonstrated that more than two parties on one line is not cherished by the subscribers. Measured rate and pay-station service had the appearance of justice, as the subscriber paid for each call he made and thus could not find fault with the company. Naturally, he became careful in the use of his telephone, thereby reducing the number of calls to a minimum and, to some extent, the company was the loser, as it had to provide a sufficiently large plant and count the number of calls, either by mechanical devices or by writing out tickets; the latter is probably the method mostly in vogue. The writing of tickets is cumbersome and reduces the efficiency of the operators, and besides, is apt to make the subscriber suspicious of overcharge, as the subscriber has no control over the operator. However, the public gained an advantage in not having to pay an exorbitant rate for a small number of calls, but the rate per call was still high, as the telephone company made the measured rate correspond to the decrease in number of calls.

It is a well-known fact that the greater the plant, or rather, the more subscribers are connected to one and the same exchange, the higher the rates. Seemingly the subscriber in a village has the advantage over the city subscriber. The rate in the village is, say, one or two dollars a month, or from $12 to $24 a year, while the city man pays $50 or more. But the villager reaches for his $12 only, say 100 subscribers, and in order to reach as many subscribers as the city man does, he will have to talk to other villagers and, perhaps, over his whole county, and pay toll charges for the privilege. Thus, to compare the rates the number of people reached must be taken into consideration. Service given by small units as in the case of a village is considered cheap, and many can afford a telephone in a village that could not in a city. Should it not be possible to arrange city service on the principle of village service and give every subscriber a comparatively low rate without going to means that deteriorate service? One step in that direction is made already by establishing so-called private branch exchanges. We find as an example hotels with telephones in every room for the use of the guests, the guests not paying for such service as long as they do not call for a party outside of the hotel, a small charge being made as soon as connection through the telephone exchange is desired. Such small units could be established in a great many large buildings in our large cities; still a better field for same would be found in the residence districts of our cities; usually the wealthiest classes congregate in the best localities where real estate or rent is high. The less fortunate members of the community choose less expensive quarters and so on down the scale of means. Accordingly, there are villages, so to speak, of the aristocracy, villages of tradespeople and the workingman's villages. In each of these villages a great number of telephone calls would be for people of the same village, and a flat rate could be established for such local calls that should not be much higher than the rate of the country village, and whenever a call is made outside of the local district, a small charge could be made per call, the same as the country villager pays a toll charge. This would, it is true, involve again the making out of tickets, but only to a limited extent and would not involve by far the labor on the part of the operator as when a ticket had to be made out for each and every call in the whole exchange. In the centre portion or business district of cities there will be one large office, or in very large cities, more than one, to which individual business telephones are connected. But the business man in a city transacts such an amount of business that a reasonably high charge for the unlimited use of his telephone would be, and in fact is, gladly paid as long as the service is good. However, here, too, a subdivision could be made by the use of two-party line service, which is not objectionable, as it does not deteriorate the service in general, being selective, *i. e.*, each of the two parties can be called without annoying the other party by ringing, and two not very busy subscribers will not be inconvenienced by having to use one and the same line, for only in rare cases will both parties call just at the same time, which would happen frequently, however, with four or more parties on the same line. Thus, two business subscribers, each having not enough business to demand the exclusive use of one line, could share in the line and thus reduce charges.

Such an arrangement as outlined above would tend toward large offices in the centre of cities and smaller offices in the residence portions, and the engineer would have to lay out his plans on somewhat different lines from that which he is used to now.

Measured service introduces also a large amount of bookkeeping, which would be done away with if only flat rates were charged.

The method of charging and collecting monthly introduced by many independent companies is another hardship for the accounting department and should not be encouraged. A subscriber who wants service and wants it honestly can not object to paying quarterly. A subscriber who delights in the one-sided economy of moving at the end of the month to unknown quarters, thereby cheating the telephone company and landlord alike out of a month's rent, is not a desirable customer in any sense.

The scheme of charging for telephone service would therefore be as follows: (1) For the business portion of cities a flat rate to all business subscribers and a reduced flat rate to less busy subscribers using a two-party line. Pay stations, of course, can not be dispensed with, but should only be used in certain quasi public places so as to give transients an opportunity of telephoning without having to intrude upon the regular subscriber. (2) In the residence districts, flat rates for local calls with measured service for trunk calls. Here, also, two-party line service can be used probably to still better advantage than in the business portion and would double the capacity of a small residence district switchboard.

With more than one office in the business district of a very large city, the flat rate would be different in the various offices and would be in correspondence to the average number of calls originating in the offices. A measured rate for trunk calls in addition to a flat rate for local calls should be made, I think, only outside of the business district where the total number of originating calls is low. This trunk charge would have another beneficial effect, as it would cut the calls into busy offices down to the lowest amount

and thus help to keep down the trunk expense in such busy offices, which would not be the case if the residence district subscriber, who is usually not pressed for time, could make as many trunk calls as he pleased under a flat rate.

One more word on the subject of measured rates. It is said that it is the fairest way to charge the public for what service it actually receives, and comparison is made with the charges for electric light and gas service. There is a fallacy in such comparison, because in electric light service as well as in gas service, reservoirs store the energy, *i. e.,* accumulators in the case of electric light supply and gas tanks in the other case, take care of the peak or peaks of the load curve, while in a telephone plant we can not store the energy developed by the operator, and must build our plant large enough for the highest peak of the load curve and therefore have, for say twenty-two hours of the day, a plant on our hands that is used at low efficiency. Thus the same switchboard equipment, and a line has to be built for each and every subscriber whether he calls once or one hundred times a day. It is, therefore, not more than correct to charge a flat rate, allowing certain modifications as the two-party line rate and regulate the flat rate according to the plant and service required. Size of plant and number of operators being purely a function of the number of calls, the flat rate should be proportional to the number of calls. There is another incongruity in the comparison. In electric light and gas meters the quantity of energy supplied or the time of duration of supply is measured, so that each consumer pays exactly for what he receives. In measuring telephone service, no account is taken of the time or duration of conversation, but the number of calls only is recorded. It is true that for local calls, *i. e.,* for calls between subscribers connected to one and the same switchboard, duration of conversation does not noticeably influence the operating labor and thus would not enter into the question of charge, but for trunk calls, *i. e.,* for calls that have to be transferred from one operator to the other, it is different. For local calls, one and the same subscriber is always connected to one end of his line and different subscribers may be switched onto his line; the subscriber may use his own line as long as he pleases, as nobody else would use it anyway. In the trunk line case, no subscriber is permanently connected to the trunk line and therefore subscribers may be switched onto either end of the trunk line, whenever the trunk line is free. Thus a trunk line (and toll and long-distance lines the same) may be kept "loaded" all the time, and it is clearly visible that the duration of conversation over trunk lines is an important factor and regulates the number of trunk lines, trunk sections, trunk operators, and everything pertaining to it. This circumstance is well taken care of in toll and long-distance charges. Therefore, a measured service for trunk calls seems justified and there might be also a time limit to trunk calls, but probably it would involve more labor on the operator to take account of the time than the additional income would warrant; the case of toll and long-distance lines is different, as great capital is invested in such lines, these being very long, while ordinary trunk lines are comparatively short.

So much about the kinds of rates. A few words now remain to be said as to the amount to be charged.

The easiest way to determine the charges, is to make them as high as the public will stand; but with competition in the field this method is excluded and the charges must necessarily settle down to a point where service can be given at a reasonable rate to the public, leaving a fair income to the operating company.

Under the Bell régime, the charges for telephone service are undoubtedly high enough to give a handsome profit to the operating company, while many independent companies have made the mistake to start in with too low rates. In order to determine the correct rate that should be charged to assure the operating company a reasonable profit, all items that are involved in the annual expense should be closely calculated. The depreciation factor on the plant should not be taken too low, as there are so many unforeseen incidents such as blizzards menacing pole lines, new inventions making switchboards obsolete, etc., that may deplete the treasury in a short time. The allowance for depreciation should not be below ten per cent on the switchboard; fifteen per cent on open wire pole lines; four per cent on conduits; twelve per cent on cables.

When figuring on the cost of operation, it must be taken into account that not only the salaries of operators working at the board, but also the salaries of chief operators, monitors, night operators, office managers, repair men, matron, janitor and messengers, as well as the salaries of the clerical force directly connected with the operating department, must be taken into consideration. The salaries of the officials of the company, as well as the taxes that have to be paid, are to be charged under the heading of fixed charges. A reasonable amount of rent must be charged, and in this point care should be taken not to make the figure too low, as it is often found afterward that the rent to be paid for the best location of the office is high, because the owner of the property has found out how desirable his property is and charges accordingly.

In estimating upon the cost of the aerial and underground construction, a good many local circumstances have to be taken into consideration, as the formation of the soil, whether same is favorable or unfavorable to the setting of poles, etc. In case of underground conduits there are obstructions to overcome, the streets in many cities being filled with all kinds of pipes so that it is very hard to lay additional conduit. I remember that in the city of Chicago, an amount of $1.20 per linear foot was added to the cost of the underground conduit in a certain street on this account.

As far as the maintenance of the plant is concerned, the figure should not be taken too low. Of course, on underground conduits the maintenance means very little, while on aerial lines it may be as high as $25 per subscriber per year.

It is impossible to give a general figure for all the items constituting the annual expense of the telephone plant, as size, as well as natural conditions of cities, differs. It is the work of the engineer to determine in every case all the items and make an estimate which is not too low, but at the same time economical.

In many cities lately, the administration, in giving franchises to independent companies, has taken advantage and forced the new comer to accept the most severe conditions, and even has gone so far as to fix the rates. If a city takes it onto itself to thus restrain a company, it should have investigated closely the probable cost of giving service, and should have done this under the advice of a telephone engineer who is thoroughly familiar with laying out telephone plants in general and with the city under consideration in particular. If the city administration fixes the rates, it is not more than fair to demand the city administration to make public the estimate upon which it bases such rates as it has fixed, so that an opportunity is given to the franchise-seeking company to point out in which particulars such an estimate may be unfair or even incorrect.

THE TELEPHONE STATUS QUO.

BY ARTHUR VAUGHN ABBOTT.

It is difficult to estimate the present telephonic situation without the recitation of a little history that may appear quite trite to many.

The introduction of the telephone dates from 1876, when, at the Centennial Exposition, the Bell magneto instrument was publicly exhibited. Almost immediately the patents covering this, and subsequent kindred inventions, afterward construed to cover all feasible methods for the electrical transmission of speech, passed under the control of an association, that under one corporate name after another, and in combination with its various operating and manufacturing affiliations, has been popularly collectively known as the Bell Telephone Company. The method of developing telephonic business consisted in forming a manufacturing

company whose office was that of creating the necessary apparatus, and a large number of operating companies, one in each particular territory, to absorb and use, under licence, this apparatus in serving the public. In all the subsidiary companies the parent organization took an active part always retaining a controlling interest, so that the entire telephonic business of this country was, during the lifetime of the fundamental patents, to all intents and purposes, that of a single management.

The inception and perpetuation of an enterprise to operate over this entire continent, necessitating business relations of the most heterogeneous character, required the exhibition of the keenest skill and shrewdness in the manipulation of men, and possessed the greatest advantages in uniformity, strength and coherence. Quite possibly, under any other form of organization, American telephonic development would be far behind what it is to-day, for it can not for a moment be denied that the Bell system is a most magnificent masterpiece, both of business and technical engineering.

But with all these virtues some faults appeared. Seemingly a policy of secrecy prevailed. Telephonic conventions, initiated in the earlier days, were abandoned, or held at the rarest intervals; that freedom of speech so dear to the American mind, the exercise of which developed the later inventions of the electric light and the electric railway, in a shorter period of time to a wider degree, was frowned upon even to the extent of non-technical publications. For the writer well remembers, after a popular magazine article, his general manager intimating that good telephonists should, like small boys, be seen and not heard. Search as one may, where in our transactions will one find a paper from a professional telephonist, save Mr. Carty's classic and ancient (though classic in spite of its age) exposition of electrostatic induction? The manufacture of apparatus, particularly of transmitters and receivers, was sedulously guarded and the magneto bell, the receiver and solid back transmitter stand to-day, after one and two decades of experience, unchanged and unimproved.

Nor was technical reticence and consequently impeded progress the only consequence. Gradually, in the public mind, arose an undefined feeling that something was wrong with the telephonic *"quid pro quo."* Alleged extortionate charges, coupled with complaints of poor service, were whispered about. Legislative and aldermanic investigating committees were appointed, that resembled the fabled characteristics of the month of March, for they went to work like lions, only in due process of time to subside into the most lamblike serenity. People saw only an insignificant bit of apparatus which their common sense told them could be made for a dozen dollars, for the annual use of which a charge of from $50 to $250 was made. Small wonder, then, in view of this insufficient evidence, that on the expiration of the fundamental patents, there were hosts of enterprising electricians (many of them of the locksmith and bell-hanger type) who were ready to flood the market with telephonic apparatus of all kinds, good, bad and indifferent; nor that there was a public trained and educated to embrace any telephonic relief from the real or fancied oppression of a so-called grasping monopoly. It is no part of the present paper to examine into the validity of the grounds for this state of public sentiment. But it exists, deeply and strongly rooted in the public mind, fixed therein by nearly a score of years of most unfortunate training; so firmly seated that in some cases independent exchanges, charging regular rates, have flourished and grown fat in the face of absolutely free service offered by the older company, in the hopes of crushing by the superior endurance of a powerful backing, their younger and seemingly weak rivals. So strong is this sentiment that to-day, though the Bell companies are nearly a quarter of a century old, and the Independent companies barely six years, the field is quite evenly divided between them as is shown by the statistics in table I.

TABLE I.

Item.	Bell Exchanges.	Independent Exchanges.
Invested capital.....	$320,000,000.00	$150,000,000.00
Number of exchanges...	1,500	2,811
Substations.....	1,080,000	1,198,000

During the past year about $18,750,000 has been spent on telephone apparatus, of which about forty per cent is credited to the Independent interests, and in this field 415 new Independent telephone companies have been floated.

So far as apparatus is involved, there are to-day a number of firms that can, and regularly do, produce transmitters and receivers whose clearness and volume of articulation can not for a moment be considered to be inferior to those manufactured by the older corporation. There are at least two companies that are prepared to, and do manufacture as broad and variegated a line of switchboard apparatus, are well equipped, do as good work, attain similar results, and are supplied with electrical talent equal to that of the Bell company's. So, it is possible to-day for any one to build a first-class telephone exchange, and with good care, shrewd and expert management, to give service that can not be excelled at the lowest possible price. Such, I say, is possible, but, unfortunately, it is rarely done. On the contrary, a very erroneous idea prevails in the minds of most of the Independent companies as to the requirements and limitations of telephony. A large portion of those interested therein seem to have been bitten by a kind of telephonic tarantula until they feel that a telephone exchange is a sort of Golconda. Put it in and it will run itself, rolling in dividends in a way to make the goose which laid the golden egg blush for incapacity. According to their doctrine, all one has to do is to put in a telephone (any kind of a telephone), build a line (any kind of a line), set up a switchboard (any kind of a switchboard), go away and leave it to its own devices, returning once a year to collect the dividends. For instance, the general manager of a 5,000-line Independent exchange recently remarked in answer to a question as to cost of maintenance, "Why, we don't have any maintenance, we have a new plant." And another gentleman, president of more than one telephone company, laughed me to scorn when I advised him to allow $2 per substation per year for maintenance expense, averring that ten cents per year were amply sufficient for the purpose.

Another and more vicious result of such erroneous misconception is the way in which new telephone companies are floated. Half a dozen of the prominent citizens of some town conceive the idea of a telephone exchange; an ordinance is rushed through the city council of which one or more of the "prominent citizens" are members, a company is formed; enough stock subscription raised to pay current office expenses, and the labor of erecting a few miles of wire. The switchboard and a lot of material are purchased on three months, six months or a year's time, a few subscribers connected up, and lo! a full-fledged telephone plant is in existence, which the incorporators now proceed to mortgage to some confiding trust company, using a good block of stock as tempting bonus, securing to themselves a nice profit, and incidently getting funds to pay for the switchboard and other material previously purchased on credit. How mistaken are these ideas, the financial cold breeze that blows over this country will surely demonstrate. Indeed, the preliminary puff is already felt as is testified by the present lamentable financial condition in Cleveland, for if ever the true epitaph is written over the unfortunate Everett-Moore Syndicate it will read, "Died of too much telephone."

Such a condition of affairs is partly due to unprecedented prosperity in America,

but it must not be forgotten that both prosperity and poverty progress in cycles. We are now about at the crest of the present prosperity wave, and in the flush of plenty and success men grow careless and plunge widely into all sorts of enterprises. Oh! for some Joseph that could rend aside the veil, and show the lean and hungry years of the future waiting to devour the sleek and well-fed ones of the present. But, more than all the public has been educated to regard the telephone from an entirely false standpoint, both as regards the instrument itself and the annual charge for its use. I do not believe that one per cent of the population of Manhattan have ever seen a switchboard, or that one-tenth per cent have the slightest conception of the maze of circuits that traverse the streets. How many of us, electrical engineers though we are, and so presumably familiar with at least the rudiments of telephony, know anything of the tortuous path traversed by the messages we send a dozen times a day from our desks? By the formerly universal flat-rate system, a certain charge per annum was made for each instrument, and this method indissolubly linked the telephone instrument with the price charged. This is a false unit, and the erroneous impression thus created in the public mind will take years of sorrowful and patient eradication. It is not the instrument, but telephonic service that the subscribers pay for; not the transmitter and receiver that stand on the desk only, but the conduits, cables, switchboard, trunk-line plant, the operators who patiently, night and day, await an instantaneous summons, and all the other complicated paraphernalia that complete an extensive business organization. All these and more are included in the necessary cost of service, and if only the cloud of mystery that has for so long obscured telephonic practice was dispelled, and the public taken fully into the confidence of the operating company, much of the present friction would be obviated. People would gain not only true appreciation of the service performed for them, and so be more tolerant of tariffs, but would also acquire such a knowledge of the telephonic *modus operandi* as to vastly increase the efficiency of every telephone plant. In this respect, the Independent companies are setting an admirable example. Frequent conventions take place, at which free and open discussions of all subjects of interest are held, to which all, whether friend or foe, are equally and cordially welcomed. Each week the technical papers of the land chronicle all items of progress in so free and full a manner as to display the most striking contrast to the years of grim and forbidding silence maintained by the older organization.

There appear to be five results that are certain to follow:

First—Many of the present organizations lacking in experience and strength, located in unpromising fields, will go down with the first monetary stringency, throwing by their ruin considerable disfavor on the financial aspect of telephony.

Second—The remaining Independent companies will be forced to adjust their rates until such a point is reached as to enable them to become investments of reasonable earning power, and to this end only the most carefully designed, best constructed and shrewdest managed plants can possibly survive.

Third—The rates of the Bell companies must fall until both the Bell and the Independent meet at a common level and thereafter, so far as the public is concerned, it matters little which gives service.

Fourth—The Independent companies are weak in their lack of coherence, feeble in possessing but few exchanges in the larger towns, and almost none in the great cities, and powerless in the toll and long-distance field. New York is the keystone in the telephonic arch, and when that city is captured by an Independent company, the battle will be more than half won, but judging from recent developments in this direction that time is still in the somewhat far distant future.

Fifth—An extensive and far-reaching tariff revision is the vital question of the present. If the Bell companies heed the tendencies of the times, they may yet not only retain, but revive a fast diminishing supremacy. Failing in this respect, they will be forced to meet this just demand, either by the struggle for existence in the face of the fiercest competition, or by the pressure of ordinance regulations, as has recently been witnessed in Chicago, or by such legislative action as will declare all telephone companies to be common carriers, and compel each to handle and transmit to its own subscribers any messages delivered by the other.

(To be concluded.)

TABLE II.—GENERAL TELEPHONE STATISTICS.

	Name of City.	Population.	No of Telephones.	Per cent. of Telephones.	WIRE MILES				TARIFF.																			
									Flat Rates.								Measured Service.											
									Business Telephones.				Residence Telephones.				Business Telephone.						Residence Telephones.					
					Underground.	Aerial.	Total.	Per Telephone.	1 Party	2 Party	4 Party	Multi Party	1 Party	2 Party	4 Party	Multi Party	1 Party	2 Party	4 Party	Multi Party	Excess Calls.	Com. Box.	1 Party	2 Party	4 Party	Multi Party	Excess Calls.	Com Box.
									$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
B	Baltimore ...	507,000	6,300	1.25					125	100			100	78	60						.06		1000 c 72	1000 c 62	1000 c 48		.04	
I	"	"	6,000	1.25	1,140	757	1,897	.3	48	42	32		36	30	24							.75				365 c 18.25	.05	.05
B	Boston.	560,892	23,106	4 1	47,000	7,100	54,100	2.3	162	141			116	100			1000 c 90 1000 c	1000 c 75	1000 c 66		.04		1000 c 92 1000 c	1000 c 75	1000 c 60		.04	
B	Buffalo	352,219	9,449	2.7	6,830	5,475	12,305	1.3									70 1000 c	1460 c		1000 c	.06		52 1000 c	1460 c	1000 c	365 c		
B	Chicago.	1,698,575	37,969	2.2	108,633	33,190	141,823	3.8	175				100	75	60		90 1000 c	73 1000 c	1000 c	48	.05	.05	92	73	48	18.25	.05	.05
B	Cleveland.....	381,000	13 741	3.5	28,623	13,119	41,742	3.2	84	72			60	48			60	48	36		.03	.05						.05
I	"	"	9,700	2.4	9,000	4,500	13,500	1.4	48				36									.03						.05
B	Columbus	125,560	8,503	6.8	7,964	8,164	16,128	1.9	40				24															
B	Indianapolis..	169,000	4,537	2.7	9,600	12,500	22,100	4.8	40				24															
B	Kansas City..	163,000	7,200	4 4	6,500	7,500	14,000	1.15	96	75	51		72	60	42		000 c 72 1000 c				.05	.05						.05
B	Louisville	204,731	6,604	3.2					96	78	48	36	60	48	30	18	74				.25						.025	
I	"	"	5,000	2 5					48				36															
B	Minneapolis ..	202,000	9,025	4.5	11,859	7,655	19,514	2.15	84	72	54	18	60	48	36	18	1000 c 72	1000 c 62	1000 c 48		.03		1000 c .60				.03	
B	Milwaukeee ..	285,000	8,900	3.1	12,529	5,559	18,088	2.0	96	72	60		60	48	36		1000 c 68 1000 c	1300 c 60	1000 c 50		.02	.05	1000 c 48	1000 c 36			.02	.05
B	Nashville.	86,000	3,498	4.0		1,030		.29	84	48	36		54	36	24		41				.05		33				.05	
B	New Orleans..	287,000	6,000	2.1					120				60															
B	New York....	1,850,000	63,975	3.5	152,807	2,455	155,262	2.25	240								1000 c 99 1000 c	1000 c 87			.08		1000 c 90 1000 c	1000 c 87	1000 c 78		.07	
B	Omaha	102,000	3,851	3.7	3,571	1,758	5,326	1.4	90	72	48	24	66	48	36		72 1000 c	1000 c			.04		72 1000 c	1000 c	400		.04	
B	Philadelphia ..	1,400,000	23,438	1.7	72,618	7,808	80,426	3.5	160								78	86			.05		69	60	36		.05	
I	" ..	"							80	52			48	36														
B	Pittsburg	451,512	11,986	2.5	22,388	13,227	35,615	3.0	125	100	80		100	80	60		1000 c 70 1000 c				.04		1000 c 70 1000 c				.04	
B	Rochester	162,608	4 200	2.6	11,550	800	12,350	3.0	94	64			36	24			70				.06		36				.04	
I	"	"	4,200	2.6	3,124	2,211	5.335	1.25	48				30	24														
B	San Francisco	342,000	29,735	8.5	23,565	7,100	40,665	1.4					66	60			1000 c 140 1000 c	1000 c 124 1000 c		365 c 18.25	.05					365 c 18.25	.05	
B	St. Louis.. ...	575,238	7,851	1.4	8,465	11,940	20,405	2.6	150	100			72	48			69 1000 c	57			.04		37	5			.04	
B	St. Paul.....	166,000	5,715	3.5	7,356	3,297	10,653	1.9	84	72	54	18	62	48	36	18	60				.03						.03	
I	"	"	1,314	.8					48				30															

NOTE.—This table is compiled from various sources, and is believed to be fairly accurate within about six months.
In the first column the "B" and "I" signify Bell Plants and Independent Plants, respectively. Under Measured Service the letter "c" signifies "Calls."

The Keystone Telephone Company's Exchange and Plant at Philadelphia.

One of the Largest and Finest Independent Exchanges yet Constructed.

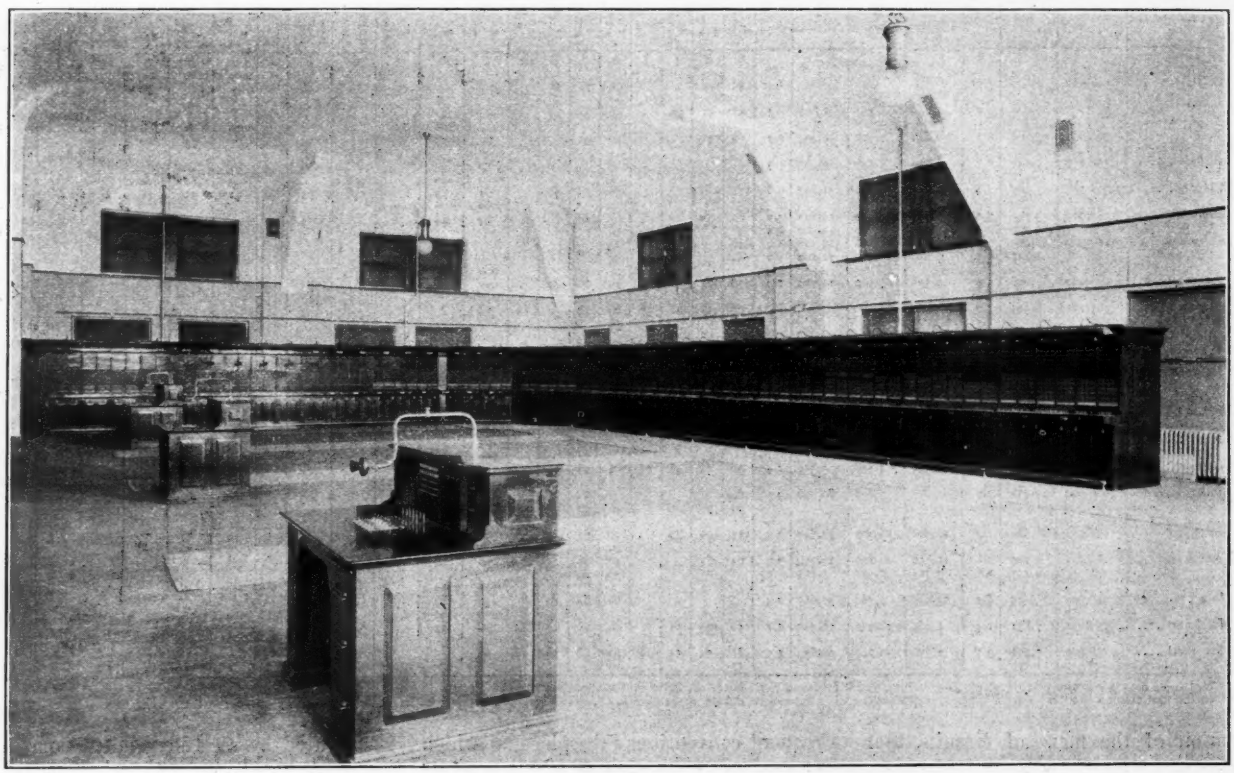
THE KEYSTONE Telephone Company, of Philadelphia, Pa., was organized in April, 1900, and during the same month received its franchises from the city government authorizing the company to lay its conduits, erect its poles, lines of wires and cables, etc., and erect buildings and maintain and operate a telephone exchange system in the city and county of Philadelphia. The plans of the company were made on a large scale, with reference to the probable future growth of the enterprise, and in May, 1900, Dr. Louis Duncan was employed to prepare preliminary plans and make estimates of the probable earning capacity and business of the plant. On the basis of these estimates the company proceeded to work, and a large corps of engineers was employed in the preparation of details, plans and specifications covering the underground working cables, lines, buildings, switchboards, instruments and all the other details going to make up the complicated plant of an operating telephone company.

In February, 1901, the capital stock of the company was increased from $2,000,000 to $10,000,000. Work was commenced on April 25, 1901, and during the remainder of that year 4,250,000 duct-feet of conduit were laid in the central portion of the city, covering seventy-five miles of streets. Upon this system of conduits were installed 1,250 manholes. A building was erected in South Second street, 95 by 135 feet in area and five stories high. In this structure are housed the company's general offices and the exchange which supplies the portion of Philadelphia lying east of Eleventh street and south of Fairmount avenue—the heart of the business and retail section of the city. The exchange in this building is known as the "Main" exchange.

At the corner of Sixteenth and Summer streets the company also constructed a building, 45 by 120 feet in plan and four stories high, for an exchange to cover that portion of the city between Eleventh street and the Schuylkill River and south of Fairmount avenue. This is known as the "Race" exchange.

Both of these buildings are of brick and terra-cotta and are of fireproof construction throughout. Both of the exchanges are of the same capacity, 3,480 lines installed and 7,200 lines ultimate. The apparatus used is the central-energy system, manufactured by the Kellogg Switchboard and Supply Company, of Chicago, to specifications of the engineer of the Keystone Telephone Company.

The station instruments were manufactured by the American Electric Telephone Company, of Chicago, also to specifications furnished by the Keystone company.

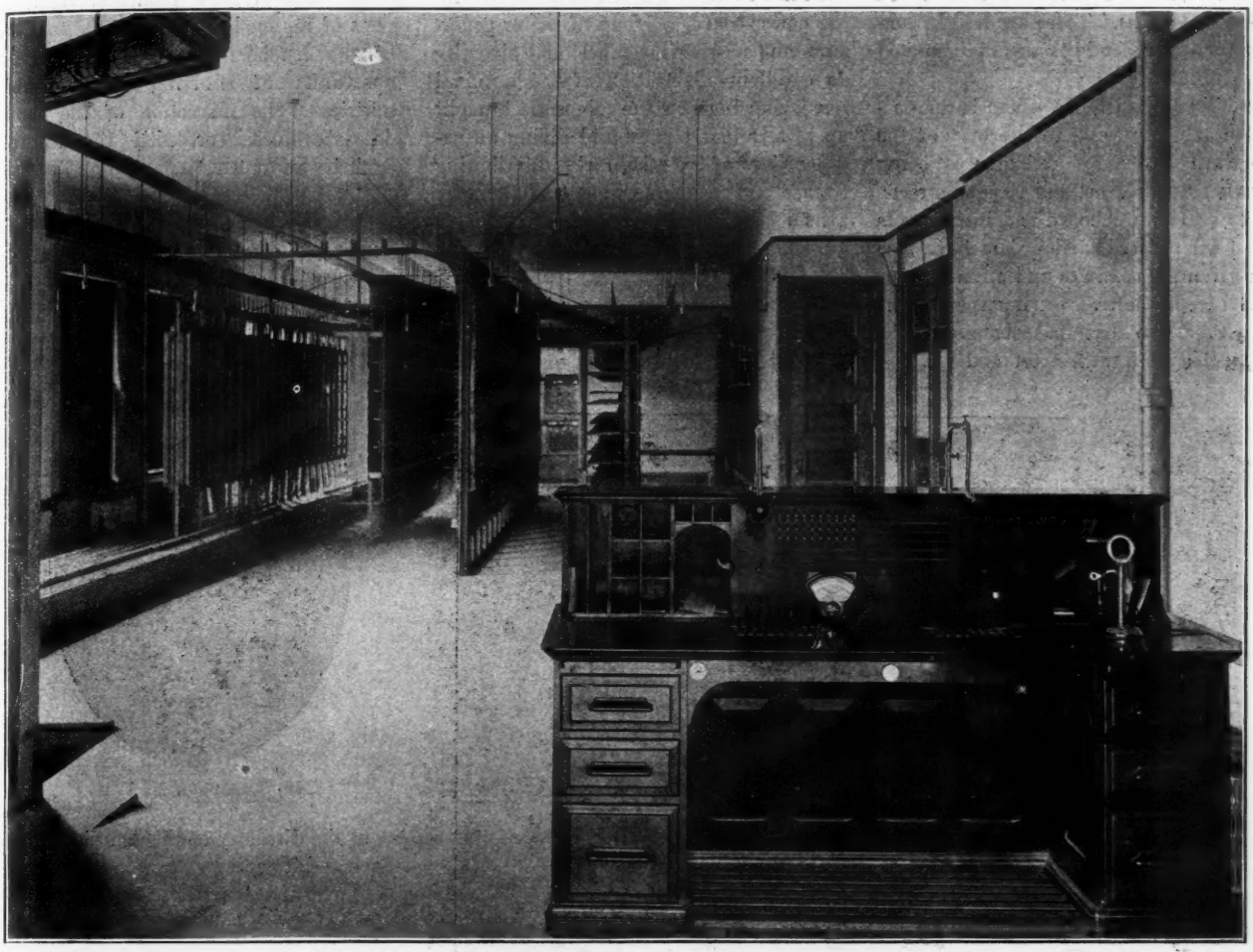


Main Switchboard and Operating Room, Keystone Telephone Company, Philadelphia, Pa.

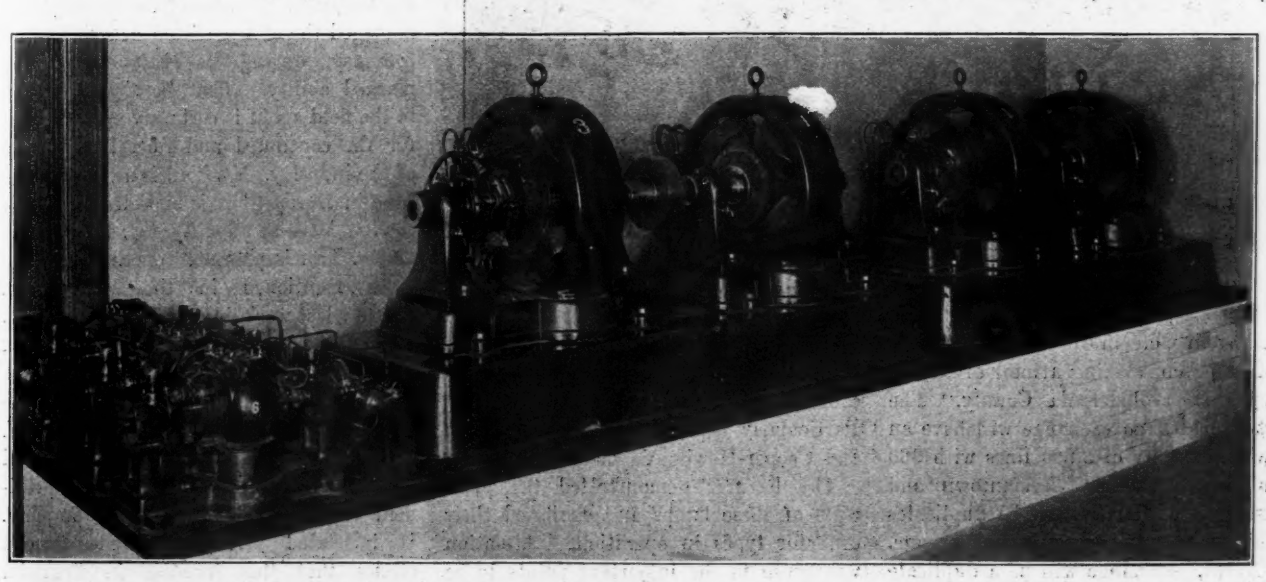
The Main exchange board has been in operation about five weeks. The Race district board will be put in operation on May 1, and both exchanges will be in operation practically within one year from the date on which ground was broken for the installation.

All of the main cables were furnished and installed by the American Electrical Works, of Providence, R. I. In the Main district all of the cables are now completed, and about 1,000 telephones are in operation, additions being made at the rate of about fifty per day.

All of the larger office and other buildings, in the districts of the city covered by this cable network, are connected directly to the underground system. Smaller buildings are connected from junction-boxes on the rear walls. So far the company has erected no poles, and it is not its intention to erect any except, perhaps, in the suburban parts of the city. The wisdom of this method of construction was proved in the recent storm when, although other systems of communication were greatly damaged by sleet and broken wires, the lines of the Keystone company suffered no damage whatever.



TERMINAL ROOM, RELAY RACKS AND WIRE CHIEF'S DESK, KEYSTONE TELEPHONE COMPANY, PHILADELPHIA, PA.



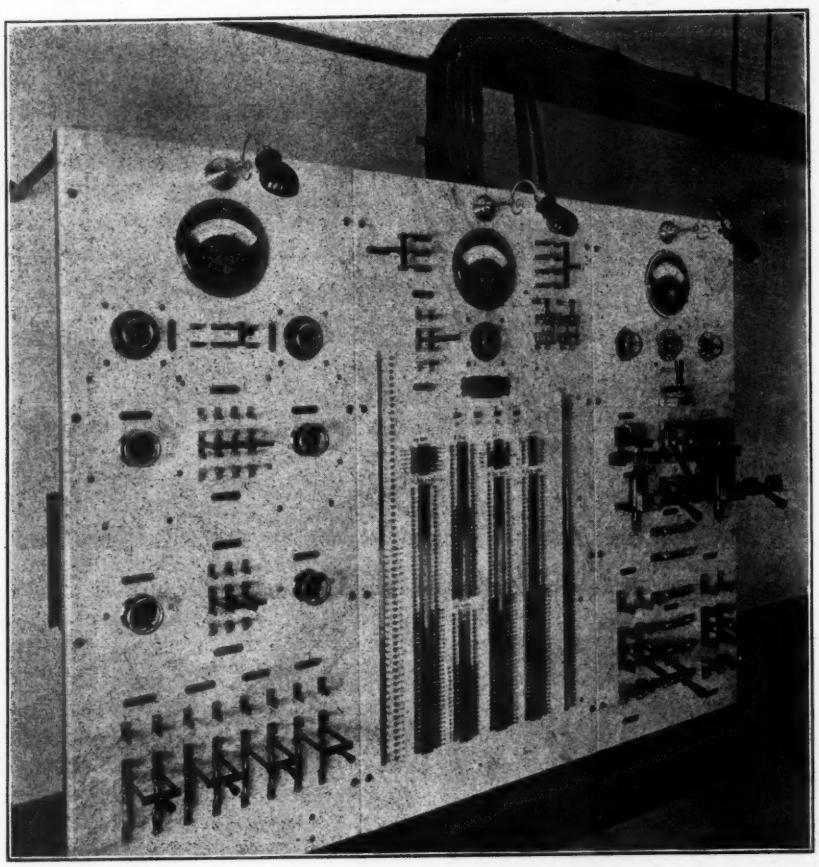
GROUP OF MOTOR-GENERATORS AND RINGING MACHINES, KEYSTONE TELEPHONE COMPANY, PHILADELPHIA, PA.

The first directory, comprising about 1,000 names of subscribers, was issued on March 1. The company now has upward

of 9,000 five-year contracts for service. All of the main conduits used are of the quadruple or four-duct type with three and one-half-inch square holes made up in three-foot lengths. These are laid in concrete. Lateral conduits are of creosoted wood.

In West Philadelphia, which is the portion of the city lying to the west of the Schuylkill River, an exchange is being constructed at Filbert and Preston streets. For this the switchboard and instruments have been ordered, and orders have also been given for conduits and all other material except cables. During the year it is expected also that an exchange will be constructed at Tenth street and Susquehanna avenue, one in Germantown and one in Kensington, making a total of six exchanges in Philadelphia County. The West Philadelphia exchange will have an ultimate capacity of 2,880 lines with 960 lines installed. The Germantown and Kensington exchanges will be duplicates of this plant. The Susquehanna avenue, or "North," exchange will be a duplicate of the Main exchange.

During the year it is expected to lay about 5,000,000 feet of conduit, covering about 120 miles of streets.



POWER-BOARD, KEYSTONE TELEPHONE COMPANY, PHILADELPHIA, PA.

The accompanying illustrations are made from photographs taken in the recently completed Main exchange and show the main switchboard and operating-room, the power-board, a group of motor-generators and ringing machines, and give also an excellent illustration of the terminal room, showing how the cables are brought up to terminal frames and giving an excellent idea of the relay racks, distributing frames and the arrangement of the wire chief's desk.

New York Electrical Society.

The 223d meeting of the society was held at the Hebrew Technical Institute, by courtesy of the directors, on Thursday, April 3, at 8 P. M. Dr. Max von Recklinghausen, of Berlin, lectured on "Recent Developments in Electric Lighting, Particularly in Reference to the Nernst and Cooper-Hewitt Vapor Lamps."

The lecturer demonstrated the principle of these lamps and exhibited their different types in operation. Attention was given to the important points to be considered when comparing artificial illuminants of various kinds.

The new building of the institute, containing shops and laboratories, was open for inspection, students of the institute working in the electrical laboratory, performing a number of interesting experiments. The Hebrew Technical Institute is one of the model schools of the country and the members of the society had an opportunity of studying its admirable facilities. The inspection of the shops and laboratories preceded the lecture, which began at 9 P. M.

Mr. Theodore N. Vail.

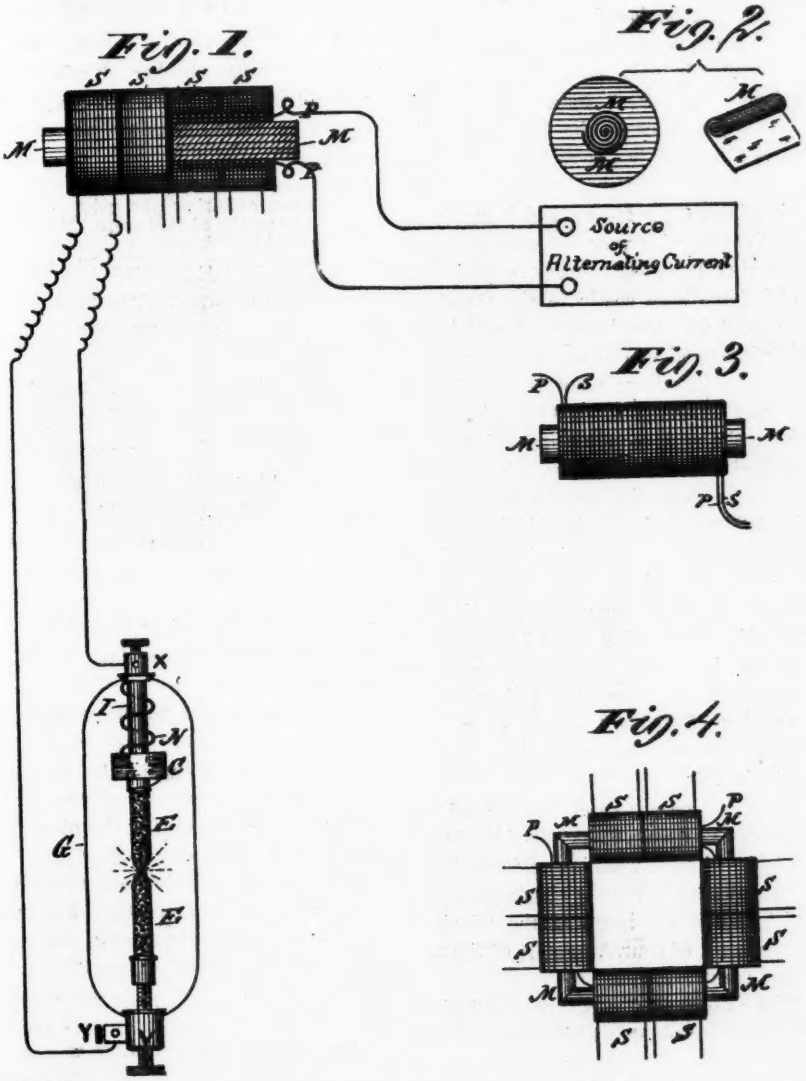
That Mr. Theodore N. Vail, formerly general manager of the American Bell Telephone Company, has become a member of the directory of the American Telephone and Telegraph Company, which has taken over the American Bell holdings, is a fact of much interest to the telephone fraternity. Mr. Vail was for years identified with the progressive building up of the telephone business of the country and managed the affairs of the American Bell company, during its early days, with marked ability. That he should return to the field again is certainly a good omen for the continued and liberal expansion of the industry. Mr. Vail is at the present time in Europe, but is expected to return to New York at an early day. A portrait of Mr. Vail is presented on this page.

MR. THEODORE N. VAIL.

As mentioned in the ELECTRICAL REVIEW last week, in addition to Mr. Vail, two prominent financiers of New York city are added to the board of directors of the American Telephone and Telegraph Company. These are Mr. George F. Baker, president of the First National Bank, and Mr. John I. Waterbury, president of the Manhattan Trust Company. It is stated throughout well-informed circles that this increase in financial strength points to closer relations between the two telegraph companies, the Western Union and the Postal, and the American Telephone and Telegraph Company.

Electrical Patents

Messrs. Elihu Thomson, of Lynn, Mass., and Edwin J. Houston, of Philadelphia, Pa., have just received a patent on a new electric lighting system which relates to an induction apparatus whereby electric currents—alternating, interrupted or varied—upon one circuit may produce electric currents on a separate or independent circuit to be utilized in the production of electric light or other purposes such as motive power. Application for this patent was made more than fifteen years ago. The idea is to provide means whereby electric energy generated at one point and supplied to an electric circuit may be utilized at another point in the shape of a current of low electro-motive force for the production of electric light on a separate circuit. It also affords a means whereby a single alternating current generated at one point and flowing over an electric circuit may be utilized in the production of an indefinite number of lights at any other point, the character of the current operating the lights being adapted in quantity to the light apparatus and not being necessarily of the same character or of a higher electro-motive force than the main or inducing alternating current, as would be the case in induction coils if the ordinary construction were employed. In the practice of the invention a single varied, intermittent or reversed current is employed through the agency of coils of insulated wire to magnetize a soft iron core, by means of which varied, interrupted or reversed currents are set up in one or more peculiarly constructed and arranged coils surrounding said core. These latter are employed through the agency of any suitable device to produce the light or lights required or to perform other work. In the accompanying illustration Fig. 1 is a diagram of a form of apparatus embodying the invention. Fig. 2 shows a detail of construction. Fig. 3 illustrates a modification in the disposition of the primary and secondary coils. Fig. 4 shows diagrammatically the preferred form of the invention. In Fig. 1 is shown one form of the invention which may be modified to suit the peculiarities of conditions of working. The soft iron core MM is constructed, as shown in Fig. 2, by rolling a sheet of thin iron, whose width is equal to the length of the core desired, into a close spiral around an iron rod which passes through its centre. The sheet is coated before rolling with varnish or some other pliable non-conducting material. By means of this arrangement a thorough subdivision of the core is obtained, whereby the circulation of induction currents is prevented without unnecessary loss of space. The core MM is surrounded by a coil or coils PP, whose terminals are connected with the circuit leading from a source of currents which are varying, interrupted or reversed. The core MM is also surrounded by coils SSSS, having free terminals which are to be connected with the arrangement for producing the light, here typified as two carbon electrodes EE, contained in a closed transparent case. The latter coils differ from the secondary coils in the well-known Ruhmkorff apparatus in being constructed of coarse wire, whose electrical resistances are much less than the resistance of the carbon contacts connected to these terminals and used as the source of light. This latter relation of resistances is a vital feature in the application of the invention. The coils SSSS differ also from the secondary coils of the ordinary Ruhmkorff apparatus, in that they require no special insulation since the electro-motive force of the currents developed in them is comparatively low, and being produced in a circuit of very low resistance the heating power of said currents is high. The coils SSSS may, in fact, be used for the primary PP. In this case the coils are preferably wound together—that is, winding a double length of wire in such a manner that the two wires shall be parallel and side by side throughout their entire length, as shown in Fig. 3. In this case one coil subserves the purpose of the coils PP, while the other coil serves the purpose of the coil SS. The obvious equivalent of the latter method is to wind the two coils PP and SS in alternate, single layers to subserve the same end. The two coils being of the same or sub-



FIGS. 1–4.—ELECTRIC LIGHTING SYSTEM.

stantially the same gauge and the secondary being divided into sections, which may deliver currents independently of one another, as indicated in the other figures, the section of the secondary will be less than that of the primary and the sum of the currents evolved in said secondaries will exceed in quantity the quantity of the inducing current. The effect produced in the coils SSSS by the passage of a reversed current through the primary coils PP may be intensified by joining several cores MM, Fig. 4, with their accompanying coils, in such a position as to form a hollow polygon or endless magnetic core of suitable dimensions, and so that the magnetic polarization in the passage of the current through the coils PP will be in the same direction in the chain of cores so provided. The coils PP being connected in series, as shown, will take the alternating or other current through all the others. The coils SS, having independent or free terminals, may supply currents independently of one another to any circuit or circuits in obvious manner. This structure provides an endless core with primary and secondary coils embracing practically the whole peripheral length, the primary being in series and the secondaries in independent section from which the currents of large heating effects may be drawn.

The First Telegraphic Train Despatcher.

Mr. A. H. Copeland, a native of Middlebury, Vt., claims the distinction, according to a Boston *Herald* correspondent, of being the first man to use the electric telegraph in the despatching of trains. It appears that in the winter of 1852, at which time Mr. Copeland was assistant postmaster at Middlebury, the telegraph was considered rather an auxiliary of the postal service, though not officially connected therewith, and the telegraph office was in the rear room of the building containing the post office. Mr. Copeland was the telegraph operator. Learning one evening that a northbound mail train from Boston, on the Burlington & Rutland Railway, was stalled in a snowstorm near Middlebury, and there was due a southbound accommodation train scheduled to pass the mail at Brandon, a station midway between Rutland and Middlebury, by an interchange of messages it was found that the mail was at Rutland and it was arranged that the mail should be held there to await the arrival of the accommodation then at Brandon. Subsequent arrangements were made by conductors, the idea working so well that it soon became a common thing for conductors to agree as to meeting points by using the telegraph.

INDEPENDENT TELEPHONE SECURITIES.

BY GUY M. WALKER.

It would be manifestly unfair to compare the independent telephone companies, almost all of which operate in very small cities, and which are consequently operated at a very low cost, with the Bell companies, in which a great majority of the telephones are found in the largest cities where the cost of operation is the highest. Particularly would it be unfair, for instance, to use the Independent plant at Cleveland, Ohio, as the basis of comparison for the independent companies; first, because the Cuyahoga Telephone Company has been made the "trial horse" for the whole independent system. It has been the plant on which nearly all experiments with new schemes and new apparatus have been made, experiments which have been costly to the Cuyahoga company, but the benefit of which the other independent companies have reaped. Next, the Cuyahoga plant is built for an ultimate capacity of 20,000 telephones, having the cable, conduit and switchboard installed for this number. The consequence is that the Cuyahoga company with 9,700 telephones installed has only made productive one-half of its total investment of capital. The result, therefore, of the Cuyahoga operation is that the active productive use of one-half of its plant is actually paying its operating expenses, maintenance, fixed charges and a surplus of $35,000 a year on a total investment twice that which is active and producing.

Of the present capitalization of the Cuyahoga company, $500,000 of bonds and $750,000 of stock were issued for building a magnificent ten-story business block, which, while the home of the telephone company, is, of course, no part of the telephone plant.

The Columbus Citizens' Telephone Company, a plant which owns no real estate, and which was only built for an ultimate capacity of about 6,000, has installed almost the total number of telephones which it is capable of installing. This plant was installed in the spring of the year 1900, and began operations in August of that year. It began with about 3,000 subscribers. During the year which elapsed, from August 31, 1900, to August 31, 1901, the total number of subscribers of the Columbus Citizens' Telephone Company increased from about 3,000 to about 5,000.

Its total gross earnings for the year were	$148,495 12
Operating expenses	67,235 67
Net earnings	$81,259 45
Interest on Bonds	27,078 75
Surplus	$54,180 70

The bonded debt of the company was $600,000, which represented the entire cost of the plant. The net earnings of the company, therefore, represent about fifteen per cent on its actual costs, or three times the interest on its bonded debt. It was capitalized with $750,000 of stock, on which it paid during its first year $45,000 in dividends, being six per cent.

The average number of telephones in use during the year was about 4,000, and the gross revenue per telephone about $33.

The gross earnings of this company during the past nine months of 1901 were		$112,747 87
Operating expenses	$27,922 59	
Maintenance and general expenses	25,306 39	
Total operation		53,228 98
Net earnings		$59,518 89
Taxes and fixed charges		21,828 77
Surplus for stock		$37,690 12

From this it will be seen that the company has made a very considerable expenditure on account of maintenance, and this plant, which has installed telephones approximately to the capacity for which it was built, is maintaining itself and showing earnings equal to about three times its fixed charges.

These are actual results, and in order that it may be seen that they are not altogether exceptional, I will quote briefly from the reports of two or three other companies showing the operation of plants in different-sized cities.

The Lancaster Telephone Company, in a city having a population of less than 10,000, made the following showing for the first nine months of 1901:

Gross earnings		$5,479 14
EXPENSES:		
Operating	$1,187 92	
Maintenance	858 12	
General	215 16	2,261 20
Net earnings		$3,217 94
Taxes and interest		1,081 30
Surplus		$2,136 64

This company is expending about sixteen per cent of its gross earnings for maintenance alone, and in spite of that fact is earning more than three times the interest on its bonds.

The Massillon Telephone Company, in a city with a population of about 18,000, made the following showing during the same period from January 1 to September 30, 1901:

Gross earnings			$9,641 93
Expenses:			
Operating	$2,048 52		
Maintenance	1,681 10		
General	831 43		4,561 04
Net earnings			$5,080 69
Taxes	$77 20		
Interest on bonds	1,875 00		
	$1,952 20		1,952 20
Surplus for stock			$3,128 69

This company is also expending about sixteen per cent of its gross earnings in maintenance alone, and it, too, is earning almost three times the interest on its bonds.

Neither one of these two companies at Lancaster and Massillon has yet reached the ultimate capacity of its plant, but is utilizing only about three-quarters of its invested capital.

At Youngstown, a city of approximately 50,000 people, the telephone company shows earnings for the first nine months of 1901, as follows:

Gross earnings			$19,637 18
Expenses:			
Operating	$3,584 34		
Maintenance	3,182 88		
General	2,474 47		9,241 69
Net earnings			$10,395 49
Taxes	$1,492 47		
Interest on bonds	6,000 00		7,492 77
Surplus for stock			$2,903 02

In this company again is to be seen the fact that these independent companies are expending for the maintenance of their plants a sum equal to from fifteen per cent to twenty per cent of their gross earnings. The reason that the surplus of the Youngstown company does not show up so large as in the other companies quoted before is again due to the fact that the Youngstown plant like the Cuyahoga plant has scarcely made productive one-half of its capital invested, the plant being built for a very much larger ultimate capacity than has yet been installed.

As a matter of fact telephone investments and independent telephone investments especially are entitled on their earning power to a very favorable consideration by investors, the independent companies particularly being fortunate in having delayed their period of activity until the time when telephone development has reached a high state of perfection. The independent companies have benefited largely from the fact that nearly all independent plants are now entirely new and built of the very latest and best construction, material and apparatus, thus obtaining the most economy in operation and the minimum of expense for maintenance.

Remarkable as have been some of the results obtained by recently constructed independent telephone plants in economy of operation and maintenance, they have far from reached the limit in this direction, and I have no hesitation in saying that the operation charges, which in the case of the Cuyahoga Telephone Company amount to from $18 to $19 per telephone, and in the Kinloch Telephone Company, of St. Louis, which amount to about $32 per telephone, will be reduced by good management to a figure approximately that attained by the Columbus Telephone Company, *i. e.*, about $12 per telephone.

Nor is the item of depreciation as connected with telephone properties and street railway companies entitled to the consideration which is usually laid upon it by experts, for experience has shown that the growth of population and the increase of business render the franchises and earning power of these companies so much greater, that their net earning capacity easily increases to an extent far more than enough to carry the additional capital account necessary to effect a complete reconstruction of the plants as often as that may become necessary.

The real weakness of telephone securities lies in the uncertainty of the total investment necessary to build any given plant. Experience has shown that the public demand for telephone service is growing so rapidly that the existing companies are absolutely unable to satisfy it and a plant originally projected for a given capacity finds the entire switchboard capacity subscribed for before it is ready for operation, and great numbers of subscribers clamoring for the service, and the original projectors find it necessary to double, triple and even quadruple their originally contemplated investment in order to satisfy the wants of the public for such service.

The effort to satisfy the extraordinary demand for telephone service by increasing the plant and investing the necessary capital, even though it be two, three or four times what they originally expected to invest, has often drained the resources of the original projectors. This is exactly the case of the Everett-Moore Syndicate, of Cleveland.

The success of the independent telephone companies has really been remarkable, considering the fact that they have usually been operated and managed by persons without any technical knowledge of telephones nor previous experience in the telephone business. The results accomplished, however, would warrant one in saying, that to the investor who desires to buy a single bond or a dozen bonds, that his security is good and his returns sure, but to original investors, who project the plants and make the first investment of capital, the business is undoubtedly fraught with dangers and the safest sphere of operation, and one from which the best and safest returns are secured, is in the smaller or medium-sized cities of the country.

Book Reviews.

"Principles of Physics." Frank M. Gilley, Boston. Allyn & Bacon. Cloth. 552 pages. 5 by 7½ inches. 511 illustrations. Supplied by the ELECTRICAL REVIEW at $1.30.

This work is a text-book intended for use of high schools and the like. It is a good plain practical treatise and ought to find a field of considerable usefulness. Throughout the book the use of mathematics is sedulously avoided, and the principles of physics are made plain to the pupil from the physical side. The apparatus used throughout is such as can easily be made by the experimenter.

"Simple Mechanical Working Models; How to Make and Use Them." The Model Engineer Series, No. 9. Percival Marshall, London. Dawbarn & Ward, Limited. Paper. 64 pages. 34 illustrations. Supplied by the ELECTRICAL REVIEW at 25 cents.

A number of descriptions of simple working models by various contributors have been gathered from the pages of the *Model Engineer,* and have been presented in a revised and collected form in this little handbook, with a view to providing the young mechanic with a series of exercises for his skill. The various models described have all actually been made and found to work and the editor assures his young readers that their efforts will be attended with due success if the instructions are carefully adhered to.

"*The Electrician* Electrical Trades Directory and Handbook for 1902." Published by *The Electrician*, London. Cloth. 6 by 9¼ inches. Two volumes. 1,500 and 150 pages, very many illustrations, portraits, maps, charts, tables, etc. Supplied by the ELECTRICAL REVIEW at $6.00.

This is the twentieth annual edition of the well-known "Blue Book," which has long been known as one of the most satisfactory and valuable electrical directories published in the world. While naturally it is most largely devoted to British matters, the United States division is also excellent and very complete. For those doing an export business it is an almost invaluable compendium of information concerning the electrical trades in Europe and other countries. In addition to the trades' directory the book contains much valuable biographical and other information.

"The Evils of Prosperity."

To the Editor of the Electrical Review:

In your issue of the twenty-second instant appeared an editorial entitled "The Evils of Prosperity." Truly the mind that inspired this article must have lapsed temporarily into an un-American, pessimistic mood.

The vast majority of business men, knowing the solid foundation of the electrical business, upon the premises of your article, would arrive at the very opposite conclusion.

In the infancy of any trade, more especially in one of so complex a nature as the electrical, dealing with a power so little understood, the forms of apparatus undergo rapid changes. As years advance, experience leads to the adoption of certain standard designs for specified lines of work. This is the A. B. C. of evolution; the experimental stage, followed by the adoption of standards. During the experimental stage, special designs, patterns and methods of manufacture raise the cost of the finished machine to a prohibitory point; only when the machines are standardized, and the cost of construction reduced to a minimum, does the general user participate in the utility of the new invention. Is this an evil of prosperity?

In recent years the mechanical design of electrical machines has reached a point of excellence which is eminently satisfactory, and although the zenith of perfection may not yet have been reached, the disadvantages of changes in standard designs outweigh the possible gains. The electrical engineer well knows that there is a constant advance in the types of new machinery, he has but to visit the powerhouse of the Manhattan Elevated Railroad in New York and compare the 5,000-kilowatt generators with the largest generators erected two or even one year ago, and he will be convinced that the strides made even in so short a time are simply prodigious.

The mind of man is never for a moment inactive, and the fact that some apparatus is standardized is evidence that the thought and brain energy of the engineer is released from care of the standard details, and the designing of special tools, and can devote his thought more exclusively to the advance of the science and the development of newer types of machinery. Electrical apparatus as a whole is not yet standardized, although certain parts are fast reaching that much desired stage; for instance, it is for the convenience of the consumer that the sockets and voltage of incandescent lamps should be standardized, but that in no way precludes improvements in the incandescent lamp as a whole.

The writer of the editorial instances Germany and Austria as having recently suffered from industrial depression to a marked degree, and the manufacturing establishments of the United States as being crowded with work. The conclusion drawn from these premises is that the German and Austrian factories, being partially idle, have had ample opportunity to develop novel ideas, new systems and new apparatus in great abundance. The unfortunate manufacturer of the United States, being crowded with work, has lacked these opportunities, and has lapsed into the making of machinery of the "cakes of soap" and "barrels of flour" style. May it not be true that the respective conditions of the electrical trade of these countries is due to the style of apparatus turned out by them. The Teutonic brain is essentially metaphysical and analytical, its ingenuity maintaining its possessors in the foreground of inventive discovery. The tyro in the history of electrical science is fully aware that to the Germans can be ascribed some of the earliest glimmerings of advances in the field of invention, and the whole world is indebted to them for their work. But on the other hand, the application of electricity to the commercial industries of the world in its present very substantial form has not been brought about by the Teutonic nations, but by the American. It is in this country that the solid advance in manufacture, and the general application of the electrical current as a means for facilitating industrial operations have taken place. A proof of this is that the conservative English railroad companies of London have quite recently adopted the American system of traction for their underground lines, and rejected the one put forward by a German company, although the first cost of the latter was apparently far less.

One must bear in mind that the European and American methods of manufacture differ radically. A large manufacturing concern in England had recently to decide whether a contract for the electrical equipment of their shops should be placed in Europe or in the United States. The European equipment was guaranteed to last for fifteen years, whereas the guarantee from the United States was limited to three years. The price of the latter was more favorable than any that could be offered by European makers, and was accepted. But it was not the price alone that decided the placing of the contract, for the purchasers knew well that by the end of a few years, whichever system was adopted, the machinery would be more or less obsolete. This does not support the suggestion put forth in your editorial that electrical machinery is standardized, and is henceforth to be turned out like "cakes of soap."

The other day an Australian engineer in his preliminary report strongly recommended the adoption of an American system for a street car line, mainly because the system and apparatus were standardized, whereas the competing office emanating from Europe lacked this recommendation.

The Germans are doing good work in the application of polyphase current directly for traction purposes, but at present this is experimental, although bruited abroad by electrical publications, as if the trains between Paris and Berlin were already driven by it daily. In this country, where competition in the electrical business is so keen, the experiments made in any new field are seldom divulged to the public until they have emerged from the chrysalis state, and have been so thoroughly worked over in theory and practice that the manufacturer is prepared to accept a contract for a complete installation, and to guarantee successful operation.

The pessimism of your editorial is misplaced. Indeed the present prosperity of electrical manufacturing companies is a direct incentive to further experimental research. New inventions, improvements in detail, and a solid advance in design and structure are continually occurring. Were it not for these conditions the electrical publications would be far less in demand by their numerous readers. A prominent electrical engineer, connected with one of our largest manufacturing companies, in replying to a remark similar to the ideas expressed in your article, stated, "A large manufacturing company can not afford to get behind the times."

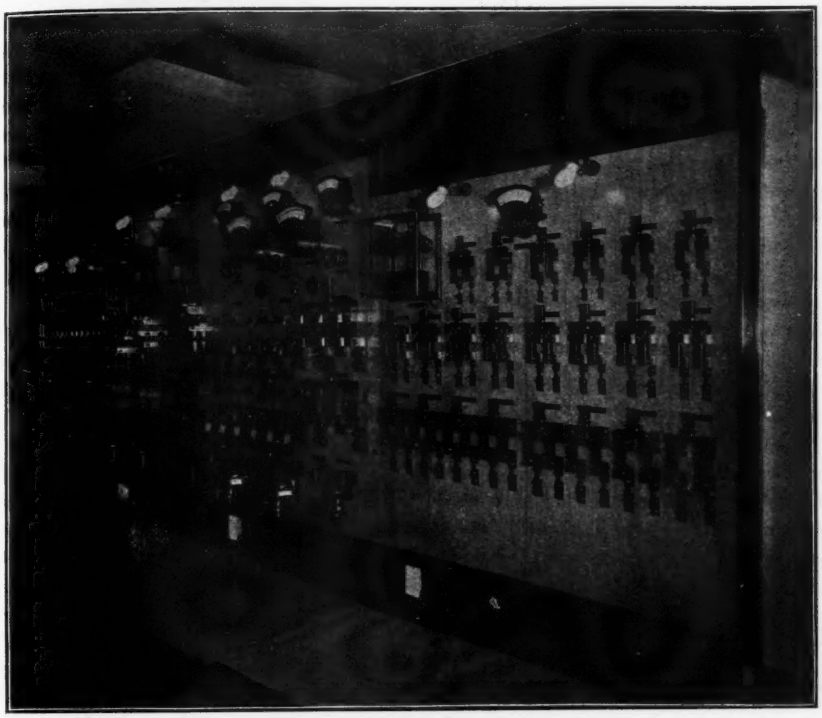
Burcham Harding.

Pittsburgh, Pa., March 25.

[Mr. Harding is the first correspondent who has ever accused us of pessimism. To foresee the evils resulting from present tendencies and suggest remedies for them seems to us to be precaution rather than pessimism. Doubtless Mr. Harding has in mind a certain great manufacturing establishment in Pittsburgh, and his vision of the truth of our suggestions is dimmed by the excellence of its equipment and management. Yet his "prominent electrical engineer" repeats the very spirit of our assertions when he says that "a large manufacturing company can not afford to get behind the times."—Eds.]

A Hospital Power and Lighting Plant.

The magnificent building of the Society of The Lying-In Hospital of the city of New York, at Second avenue and Seventeenth and Eighteenth streets, is a model in its every requirement. One of the features of the equipment of this building is the installation of electric apparatus for lighting and power. In the accompanying illustrations are shown portions of the engine-room and the switchboard.



SWITCHBOARD IN THE LYING-IN HOSPITAL.

This engine-room is forty feet wide, fifty feet long and seventeen feet in height, and contains three Westinghouse generators direct coupled with Phœnix engines. The engines are respectively of 200 horse-power, 300 horse-power and 400 horse-power, driving at 100, 150 and 200 kilowatts. There is also a series booster of ten kilowatts capacity, giving thirty volts and 333 amperes. To the right of Fig. 1 is a steam gauge board six feet high and five feet wide, and one Edson recording steam gauge. Fig. 2 shows the switchboard. This is constructed of Mazise marble and is twenty-two feet long and eight feet high with eight light brackets controlling all the electricity used for various purposes in every floor of the building. There are two Thompson recording wattmeters of 115 to 120 volts and 2,500 amperes, one each for power and light and two Chauvin & Arnoux ampere and volt-registering machines for the battery, and eight other indicating volt and ampere-meters. There are eleven switches for the storage battery light and power generators and twenty-two light switches, with nine circuit-breakers, and one switch for transfer and three ground detectors.

GENERAL VIEW IN ENGINE ROOM OF THE NEW LYING-IN HOSPITAL IN NEW YORK CITY.

A storage battery room, eighty feet long, twelve feet wide and seven feet high, contains sixty cells of chloride accumulators with a capacity of 2,500 amperes and will store sufficient electricity to run the building for two days in case of any accident to boilers or machinery.

Four motors are located at different points in the cellar of the building and form part of the ventilating plant. Each of these motors drives a fan nine feet in diameter and five feet wide and supplies air for 2,500 square feet of heating surface, forcing a uniform temperature into various parts of the building for use in the wards and bedrooms. A thirty-horse-power electric motor also turns a fan eight feet in diameter and four feet wide for supplying the engine-room and fire-rooms with cool air, and also an exhaust fan to remove the foul air. A system of electric fans, sixteen in number, is used for the purpose of drawing the air from the wards and rooms while a fresh supply is forced in. These exhaust fans are located on the roof in shafts. There are also fans for air supply and exhaust in the operating theatre, one in the mortuary and one in the laundry on the top floor and another in the kitchen.

The power for ringing the bells in the different wards is supplied by a small motor-generator which has an automatic auxiliary of five cells. In each of the wards at the head of each bed is a receptacle in the wall. A portable lamp-bracket, with a cord and plug to be inserted in this receptacle, confines the lighting to any particular portion of the room. The rooms are lighted by a special method of fixture. Five incandescent lamps are suspended from the ceiling and below these is placed an inverted cone throw-

ing the light to the whitened ceiling above. A special dimming apparatus controls a part of the lights in these inverted cones, and if desired the illumination may be very much softened by manipulating the turning key in a wall socket.

An electric ambulance is a part of the equipment of this hospital, the distinctive feature of which is a method of opening it for placing the patient within. This is done by letting down and raising one each of the two side panels. The patient is placed on a stretcher and can then be easily slid in. This novel and convenient arrangement was devised by Dr. James W. Markoe, surgeon in chief of the hospital. The ambulance is lighted by small windows in the top in the daytime and by a cluster of electric lights at night, and is propelled by the usual forty-cell storage battery, being kept in a small room specially designed for the purpose and equipped with a suitable charging-board.

Tide Harness Wanted.

The current number of an English contemporary publishes the following interesting paragraph: "The vast energy of the tides round the British Isles is just now attracting the attention of several municipal councillors. Thus, both at Brighton and Liverpool correspondence in the daily press is being published on this subject. In Liverpool Councillor M'Guffie advocates the offering of a £7,000 premium for the most practical device for harnessing the tides which flow past the Liverpool docks. He has not yet persuaded the council to make this offer, and we are sure that the council will not do so if it takes the advice of its able harbor and borough engineers. It is exceedingly difficult to get the non-technical man to believe that although there is a great amount of energy in the tides, the cost up to the present of utilizing this energy makes it unavailable for practical purposes. On the score of availability the tides are unfortunately worse off than large waterfalls, and yet we know of several instances in which the utilization of waterfalls by engineering works brings the annual cost of the energy so obtained to a higher figure than would be the case if the same energy were produced in the same position by means of coal-fed boilers."

A news despatch from Wellington, New Zealand, dated March 20, says that the laying of the Australian-New Zealand section of the British transpacific cable has been completed.

The Electrical Equipment of the Library of Congress at Washington.

Electricity plays an important part in the daily operations of the Library of Congress, without doubt the finest public building in Washington. The magnitude of the building—it is 470 feet in length by 340 feet in width, covering nearly three and three-quarter acres of ground—not only required a special design of heating apparatus, but indicated a need of facilities for communication between all parts of the building and the transmission of books between shelves and reading-room superior to those ever before required in libraries. Pneumatic tubes, telephones and book-carriers were therefore devised and installed that are unique in many respects.

Steam for all warming and power is supplied by sixteen 60-horse-power boilers in two batteries located under the parking, near, but quite outside, the building at the east front. There also are the elevator and house pumps and the coal vaults of 3,000 tons capacity. About one-half of the boilers is under steam at one time, operating the main electric-lighting engines from dusk until 10 P. M. every week-day except holidays, and the elevator and the book-carrying machinery, ventilating fans and pneumatic-tube apparatus all day and evening of the same days, and for lighting the grounds every night the year round. Three thousand four hundred tons of coal are consumed annually. Probably two-thirds of the warming of the building during cold weather is obtained incidentally without extra cost from the exhaust steam of the engines and pumps.

The heating apparatus is located almost entirely in the cellar, and is on the so-called indirect system, which combines the warming with the ventilation of the building. Fresh air, taken direct from the outside, is heated by warm-water coils in separate stacks distributed throughout the cellar and carried in closed ducts and flues direct to the respective rooms. The water coils are arranged in six separate divisions, each with its system of circulating pipes and a pair of heaters or "hot-water stoves," wherein the water is heated by low-pressure steam from the engine exhausts or direct from the boilers, as conditions may require. Warming and ventilation are thus accomplished by steam through the medium of circulating warm water. It is probably the largest existing apparatus operated on this unusual plan, found to be the most economical for the extensive area covered by the building. The ventilation is mainly natural, by means of direct flues from the rooms to the roof. A few electric blowers are used for the main reading-room and book-stacks in summer.

For day lighting the building contains some 2,200 windows and extensive skylights. For night service there are 7,624 incandescent electric lamps of various powers, equivalent to 9,863 of the ordinary sixteen candle-power. Of these the equivalent of about 4,900 sixteen candle-power is in nightly use until ten o'clock, while the Library is open to the public. The grounds are lighted all night by 184 lamps. The electric generating plant, located in the cellar, consists of three 100-kilowatt and one 25-kilowatt dynamos, driven by steam engines of about 400 horse-power in all.

The passenger elevators are located in the main stair hall, one large elevator for both passenger and freight near the rear entrance, one in each of the three book-stacks, one in the reading-room, one in the rear area and one in the boiler-room, all operated in one hydraulic system by a single pump. The building is provided with a local telephone exchange connected with the Capitol and city exchanges, by which communication with the Library may be had at all times, not only from all parts of the Capitol, but from any telephone of the public exchange.

The book-carriers consist of a pair of parallel endless sprocket chains, twenty and one-half inches apart, driven throughout the day, without stop, by a small electric motor at a speed of 100 feet per minute. The chains run over sheaves of such size that the book trays, hanging on trunnions between the chains, may pass freely over the axles at the several changes of direction along the route.

Electric Light in Nicaragua.

A monopoly to light the chief towns of Nicaragua has been secured from President Zelaya by a party of Americans who left Greytown recently. Dynamos, wire, carbons and all the necessary paraphernalia to do the work were carried with the party. The Nicaragua Electric Light Company, which was organized in New Orleans a few weeks ago, will carry out the work.

There will be two plants, one at Managua, the capital, a town with a population of 25,000. The other, which will obtain its power from the falls of a river, will illuminate the three cities of Don, Granada and Messaya, with a joint population of 80,000.

CONVENTION OF THE INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

THE CHICAGO MEETING OF THIS INDEPENDENT TELEPHONE BODY PROMISES A LARGE ATTENDANCE.

The initial meeting for organization of the Interstate Independent Telephone Association, which will be held at the Sherman House, Chicago, on April 9, 10 and 11, already exhibits every indication of being a gratifying success. The object of the meeting is to form a strong association of actual operating independent telephone interests of the middle western section of the United States. In this district of the country, as is well known, there is much the largest development of independent telephony that exists anywhere.

Arrangements have been made for special railroad rates from all points in the seven states of Illinois, Wisconsin, Michigan, Indiana, Kentucky, Missouri and Iowa. An elaborate programme has been prepared for the entertainment of those in attendance, in addition to which a number of interesting and instructive papers will be presented. No less than three state associations have advised the committee of arrangements that they will be present in a body and a very large attendance is anticipated. The arrangements of the committee have included special rates at the Sherman House and a banquet on the evening of April 9, which will be given by telephone manufacturers, supply houses and dealers who have contributed very largely for this purpose. Invitations have been issued to all independent telephone men, emphasizing the importance of the occasion. A large number of elaborate exhibits have been prepared by manufacturers of telephones and telephone apparatus, and it is believed that this first convention of the new association will be one of the most important that has marked the history of the independent telephone development.

WESTERN OFFICE OF "ELECTRICAL REVIEW."

The western office of the ELECTRICAL REVIEW has been removed to 412-413, No. 40 Dearborn street, corner of Lake, Chicago. It is in charge of Mr. Charles Ffrench, who has for years been indirectly associated with the ELECTRICAL REVIEW, and is a practical newspaper man. Mr. Ffrench now assumes control of the western business, and will at all times be glad to see at his office friends of the ELECTRICAL REVIEW, and those who in any way are interested in electrical matters.

The Telephone and Telegraph Interests of the United States.

The Wall Street *Journal*, in reviewing the telephone-telegraph situation of the country in its issue of March 27, says:

A gentleman thoroughly familiar with the telegraph and telephone situation says that the formation of the new Western Telephone and Telegraph Company was the first move toward an amalgamation of all the telephone interests in the country working under the American Telephone and Telegraph Company patents. The recent appointment of the president of the Cumberland Telephone Company as president of the southwestern division of the new Western company, and the appointment of the president of the Nebraska company at the head of the northwestern division of the Western company and the appointment of the president of the Missouri-Kansas company at the head of the Wisconsin company is a step of progress in the direction indicated.

The saving by a consolidation of the telegraph and telephone interests in operations will be at least thirty-three per cent. At present there are three extensive lines of wire communicating facilities all over the country used only to about seventy-five per cent of their capacity.

The amalgamation would dispense with at least two-thirds of the offices where there are three in any one city or location as one manager with assistance can handle both the telegraph and telephone, the operation of which is so nearly alike. The same is true regarding the repair and reconstruction forces. There being twenty-five per cent excess wire facilities no new copper wire would be required for many years. No consolidation of interests offers a better opportunity for financiers than that of the telegraph and telephone, and when made the quality of the service at a less rate than that now charged with the enormous facilities would improve.

A telegraph man says: "I believe that these interests can be put together on a basis of $300 for Bell, $150 for Western Union and $250 for Postal and Commercial cable and the capitalization be far below the capitalization of the steel properties or many others that have been successfully floated."

Foreign Uses of Oil Fuel.

The United States consul at Cardiff, Wales, Mr. Daniel T. Phillips, has been the recipient of enquiries as to the likelihood of oil fuel being introduced there. After considerable investigation, he has made the following interesting report:

I venture to prognosticate that this new combustible is destined ere long to revolutionize the coal markets of the world. The abnormal cost of steam coal in Great Britain—particularly in Wales—and the exorbitant price of the best coal (£1 6s., or $6.50, per ton) are calculated to hasten this revolution.

An impetus was given to this industry five years ago, when petroleum discovered in Borneo was found to be well adapted for fuel purposes. This field is owned by the Shell Transport and Trading Company, Limited. Last year (1901) the exports exceeded 100,000 tons.

The Dutch Steamship Company uses this fuel in its boats; the Hamburg-American Line has built four new steamers adapted for oil fuel, and run them in the Eastern trade with marked success; the North German Lloyd has two local steamers using oil; the East Asiatic Company, of Copenhagen, employs this fuel in its local boats, and is building two ocean-going steamers with the intention of using it; and the China Mutual is preparing three boats for the employment of oil.

The prejudice against this sort of fuel is passing away. Several firms are contemplating a change in their method of steam production, which they predict will be as safe as the old method and more economical. The advantages are said to be:

First. The saving of labor is large; there will be no ashes to hoist overboard after each watch; no need of stoking. All that will be necessary will be to watch the water in the boilers; the feeding of the fuel to the furnaces will be automatic.

Second. Fewer deck hands will be needed, as the dirt caused by coal shoveling will be done away with.

Third. Under proper combustion no smoke will be generated; every atom of oil is of calorific value; there is no residue.

Fourth. The fuel may be stored in the double bottom of a ship, the forepeak, afterpeak, and tanks under the engine room, thus occupying space not utilizable in any other way. No rust is possible where it is stored. The space now filled by coal bunkers is thus available for cargo; oil stores in a space of thirty-five feet per ton, as against forty-four feet per ton of coal. The last results obtained show that Messrs. Thorneycroft have evaporated 18.95 pounds of water per pound of oil in their torpedo-boat type of boiler, but in ordinary locomotive types fifteen pounds of water per pound of oil is obtained.

Fifth. The oil fuel has a higher concentration of heat for manufacturing than can be obtained with coal.

Until recently, oil fuel was held at a figure which did not enable it to compete with coal. A few months ago, however, oil in tremendous quantities was discovered in Texas, and the Shell company found that it was capable of giving the same results as are derived from Borneo oil. An enormous expansion of its use may be expected.

The Great Eastern Railway, in this country, has already a large number of locomotives using this fuel. It says that by its use steam is more easily produced and is maintained up the steepest gradients, and great economy is effected by reducing the supply of oil when descending or remaining stationary, the life of the boilers is prolonged, inasmuch as the tubes do not foul.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE.

GIVING CONCISELY THE SUBSTANCE OF IMPORTANT PAPERS IN THE SCIENTIFIC, ELECTRICAL AND ENGINEERING PRESS OF THE WORLD.

THE following paragraphs give, in condensed form, the substance of the principal articles appearing in the engineering and scientific press of this and other countries. They represent simply the gist of the article in each case, having been compiled and abstracted from the original sources, to which credit is given. The journals read for the preparation of these abstracts are the principal publications in the English, French, German, Danish, Spanish, Italian and Portuguese languages. These reviews of the technical press will appear regularly in the ELECTRICAL REVIEW.

Gelatine Engraving on Glass.

M. L. Cailletet has presented to the French Academy of Sciences a process for frosting and engraving on glass and crystal by the use of gelatine. The process consists of simply painting on a strong, hot solution of glue which is allowed to dry. As it drys it contracts and the adhesion of the glue to the surface of the glass is sufficiently strong to tear off layers of the surface, leaving a beautifully frosted design. By a mixture of six per cent or less of potash alum or various other crystalline chemicals, very beautiful crystalline patterns are obtained.—*L'Industrie Electrique* (Paris), March 10.

Nickel-Oxide Accumulators.

Two years ago zinc and nickel-oxide accumulators were recommended by T. Michalowski. A patent specification by A. Dun, Frankfort-on-Main, Germany, of early date mentions nickel oxide. Michalowski was the first to find out that nickel oxide is an endothermic compound. Compact nickel plates are difficult to prepare and porous nickel plates are not stable. Michalowski recommends this process: A grating is formed of nickel wire netting; on this an alloy of nickel and zinc is deposited by electrolysis. The plate is then placed in concentrated caustic potash. This dissolves out the zinc leaving fine pores which are afterward filled with nickel oxide.—*Engineering* (London), March 14.

Fused Quartz.

Mr. R. S. Hutton recently read a paper on the possible use of fused quartz for making vessels in which to study high-temperature phenomena and especially for high-temperature gas thermometers. The use of the oxyhydrogen flame for producing this material has not been very successful, as the flame is not hot enough. The author's experiments on the electric arc have led him to conclude that it could be used as a source of heat for fusing silica without fear of reduction spoiling the results. He used a furnace working at 50 volts and 300 amperes, in which quartz melts in a minute or two with ease. His object was to produce thick walled tubes of quartz, which he has done very successfully.—*The Electrician* (London), March 14.

Canals in Great Britain.

Mr. George Cawley, of Westminster, England, has published a pamphlet entitled "The Future of British Canals," which has an important bearing on the question of the cheapening of inland transport in that country. The author makes a plea for immediate parliamentary action in respect to canals, and is of the opinion that the improvement and establishment of canal transportation on proper business and engineering lines would provide an easy and effective competition with railways to the great advantage of manufacturers and business in general. New methods of towage are required in order to bring about a reduction of expenditures and a greater freedom of traffic.—*Electrical Engineer* (London), March 7.

Simple Frequency Measuring Instrument.

A simple apparatus for measuring the frequency of alternating currents is described by Herr K. E. F. Schmidt. In a glass tube about an inch in diameter and two or three feet long a tight fitting piston slides and is provided with a long rod, upon which is a mark running in front of a scale so that the movement of the piston may be measured. In front of the open end of the tube, and at a distance of one or two centimetres from it, is placed the diaphragm of a telephone actuated by the current to be measured. By moving the piston along the tube points of maximum and minimum loudness of tone may be found. The distance between these as measured on a scale is half the wave length of the telephone tone in air, from which the vibration period may immediately and easily be calculated. —*Annalen der Physik* (Berlin), Band 7.

Alcohol for Use in the Arts.

The problem of finding a suitable outlet for the over-production of alcohol in several European countries is engrossing much attention in the scientific press. In Spain the Ministry of the Interior has taken up the matter and is endeavoring to extend the use of alcohol for lighting, heating, and as a substitute for gasoline in explosive engines. The alcohol is of the "denaturalized" type, which means that it is mixed with a sufficient quantity of petroleum oils to make it undrinkable and thus not to bring the cheap commercial alcohol in competition with that manufactured as liquors. It is calculated that in Spain a hektare (2.45 acres) of ordinary land will produce annually $100 worth of commercial alcohol. The plant from which alcohol is distilled is the "cotufa" which resembles the potato, but is rich in sugar.—*Revista de Obras Publicas* (Madrid), March 6.

Single-Contact Coherers.

In a note by M. Edouard Branly, before the French Academy of Sciences, he describes some very interesting results obtained with single-contact coherers. Three small metal rods are made into a tripod and allowed to rest upon a polished steel plate. The behavior of this arrangement under various conditions of polish and cleanliness of the feet of the rods is very interesting. An extremely sensitive coherer of this kind is made of three sewing needles arranged in a small tripod, eye ends down, and resting on a plate of polished steel. A cell giving one-half volt is used in circuit with them. Three knitting needles with one volt in circuit give also extraordinarily sensitive results. By properly adjusting the weight of the tripod, the tension of the cell and the resistance in circuit, a coherer of great delicacy can be constructed which requires only the slightest jar to bring it back to its high-resistance condition.—*L'Industrie Electrique* (Paris), March 10.

Tantalum Made in the Electric Furnace.

In a note by M. E. Moissan, before the French Academy, he describes the preparation of the rare element tantalum in the electrical furnace. Anhydrous tantalum oxide of the formula Ta_2O_5, obtained from the fluoro-tantalate of potassium, is mixed with sugar charcoal in the quantities expressed by the equation

$$Ta_2O_5 + 5\ C = 2\ Ta + 5\ CO.$$

and the mixture is heated ten minutes in the electric furnace with a current of 800 amperes at sixty volts. A mass having a crystalline fracture is obtained. Selected specimens contain only one-half of one per cent of carbon. This tantalum is practically pure, has a specific gravity of 12.79, is hard enough to scratch glass, is infusible in the hydrogen blow-pipe, and exposed to the air slowly becomes converted into the oxide. The chemical character of tantalum is much similar to that of niobium and is more like that of the non-metallic elements than of metals. —*Comptes Rendus* (Paris), cxxxiii.

Shale Oil Manufactured by Electric Process.

The Oakbank Oil Company, at Mid-Calder, near Edinburgh, Scotland, has put in an extensive installation for manufacturing oils from shale by electric power. The works and mines are two miles apart and power is transmitted over this distance. In the production of oils from shale, the shale is roasted in retorts and a mixture of air and steam is passed through the hot mass. The gases produced are drawn off and condensed, the distillate containing a mixture of hydrocarbons carrying from light mineral oils up to paraffine wax. These are separated by the usual refining processes. The electrical plant installed at the works comprises two 400-horse-power steam-driven generating sets of the Westinghouse type, giving three-phase current at 3,300 volts. The secondary pressure for the motors is 440 volts. These are used for driving hoists, breakers, hauling gear, exhaust fans for drawing gases from the retorts and for various machine tools and for operating a light railway. All of the motors are induction motors, ranging up to 150 horse-power.—*Engineering* (London), March 14.

British and American Patent Law.

In a paper read by Mr. Percy Griffith before the British Society of Engineers, he draws some interesting comparisons between British and American patent methods. A British patent is merely a registration of date and a disclosure of the invention, is valid for fourteen years and costs $495. An American inventor is given the benefit of an unprejudiced examination and investigation by technical experts for $15, and if his patent passes through the ordeal successfully has to pay only $20 more for seventeen years' protection The chances that an American patent passes safely through a law contest are as 74 to 100, whereas the chances of a British patent being found valid are only 58 to 100. In seven American states, noted for the inventive characteristics of their people, the capital value per capita of the population is $682. In seven other states, having populations of low inventive capacity, the capital value per capita is only $176. Seven-eighths of the hundreds of millions of dollars of capital invested in American manufacturing industries are applied to the manufacture of patented articles, products or machinery.—*The Mechanical Engineer* (London), March 8.

Deflection of Becquerel Rays.

Herr W. Kauffman has conducted a highly interesting investigation of the magnetic and electrical deflection of Becquerel rays and the apparent mass of electrons. He determined the ratio of charge to mass and the velocity of the Becquerel rays produced by a small crystal of radium bromide. Since these rays are not homogeneous, but seem to consist of a mixture of various kinds of radiation, a fine pencil of them is broadened into a band when it is deflected. The author made use of the method of crossed spectra, allowing electrical and magnetic lines of force to act at the same time and parallel to each other so that the two deflections are normal to one another. The fine pencil of rays is thus made to trace a curve on a photographic plate and in this curve every point corresponds to a different value of velocity and the ratio of charge to mass. The magnetic field employed was 299 absolute units and the electrical field 44.3×10^{11} absolute units. The whole apparatus was enclosed in a completely exhausted glass tube. Exposures of forty-eight hours were made. The values of velocity and ratio of charge to mass are given in the following table:

$v \times 10^{-10}$	$e/m \times 10^{-7}$
2.83	0.63
2.72	0.77
2.59	0.975
2.48	1.17
2.36	1.31

From this it appears that the mass of the electrons increases with their velocity, which is in accordance with theory if the electron consists either wholly or partly of an apparent mass in the electromagnetic sense. The author attempting to calculate the ratio of the real to the apparent mass finds that, for velocities small in comparison with that of light, this ratio is three.—*Beiblätter zu den Annalen der Physik* (Berlin), February.

The Osmium Lamp.

The Welsbach osmium lamp was shown for the first time in public at a recent meeting of the Electrotechnical Union in Vienna. Osmium is a metal of the platinum group, and is found almost invariably in combination with iridium. It has the high specific gravity of 22.5 and is the heaviest known body. It is very hard and melts at the temperature of 2,500 degrees centigrade. It can be brought to a high state of incandescence, emitting a brilliant light before this temperature is reached. Until recently the only uses of the metal have been in the iridium alloy, which has been employed for the tips of gold pens and for some of its salts which are used in microscopy and as chemical reagents. In making the lamps the gray osmium powder is reduced to a pasty mass by a suitable mixing ingredient and squirted into filaments. These are about the size of sewing thread. They are wound into their proper form and heated to redness in an atmosphere of ordinary illuminating gas. The heating is accomplished by electricity. The filament contracts considerably and rapidly while hot and is reduced to metallic osmium in a few minutes. It has not been stated whether the bulbs in which these filaments are placed are exhausted of air or not. The consumption of the lamps is stated to be one and one-half watts per candle-power. It is also claimed that this efficiency is retained throughout the life of the lamp. In some curves which were shown a lamp beginning at 14.8 candle-power at the end of 200 hours of burning showed 16.5 candle-power and slowly diminished until, after 1,000 hours of burning, it showed fifteen candle-power. The light from the lamp is very white. It is stated that the commercial manufacture of the lamp is already well started. They are made for low voltages, twenty-five volts seeming to be standard.—*L'Electricien* (Paris), March 8.

Electrical and Magnetic Properties of Iron Alloys.

For ten years past Professor W. F. Barrett, of Dublin, and Messrs. W. Brown and R. A. Hadfield have been engaged in research on the electrical

and magnetic properties of iron alloys. One hundred and ten specimens were tested, the method in each case being to cast the metal into ingots which were then forged into bars, raised to a bright, red heat, and rolled out into rods forty inches long and 0.2 inch in diameter. These were first tested and afterward thoroughly annealed at 1,000 degrees centigrade and allowed to cool for 100 hours preparatory to further testing. Fifty-nine of the rods represented alloys of two components, forty-four of three components, and seven contained more than three elements besides iron. The standards of comparison were hard drawn electrolytic copper rods and Swedish iron rods containing only one-tenth per cent of impurity. This iron had a conductivity of 16.5 per cent with reference to copper. Resistances were determined by the potentiometer method. The highest resistance of any commercially useful wire, 97.5 microhms per cubic centimetre, was found in an alloy of iron with twenty-five per cent of nickel and five per cent of manganese. This alloy has extraordinary properties of various kinds. Looking at the general results it is noticeable that all mixtures with iron diminish the conductivity, even though the additional element be itself a better conductor than iron. The effect of carbon is so marked that in the absence of other impurities the percentage of carbon present may be estimated from the resistance. The effect of a small quantity of an additional element is much stronger than that of subsequent additions to rich alloys. Annealing always diminishes the resistance of alloys. Hardness, as a rule, grows with resistance. Chromium makes iron hard and decreases its permeability. Steel containing five to seven per cent of tungsten is excellent for permanent magnets. Composite alloys behave very curiously. A steel containing 86.7 per cent iron, thirteen per cent manganese and 0.26 per cent carbon is practically non-magnetic but, unfortunately, too hard to be of any use. A steel, however, containing 79.35 per cent of iron, 10.25 per cent of manganese, nine per cent of nickel and 1.4 per cent of carbon is also non-magnetic, but is easy to work. Steel containing two and one-half per cent of silicon exhibits higher permeability and lower hysteresis than the purest Swedish charcoal iron, and a two and one-half per cent aluminum steel is probably still superior.—*Engineering* (London), March 14.

The Berlin Elevated Railway.

The route of the new line of elevated and underground electric railway in Berlin lies to the south of the Metropolitan Railway in that city and forms almost a straight-line connection between the Warshauer Brücke and the Zoologischer Garten stations of the latter system. The plans prepared in 1891 by Siemens & Halske have been carried out with slight modifications. Most of the track is elevated, two short sections being constructed in a shallow, level subway, while a surface-level link connects the east end of the elevated track with the Central-Viehof. There are no grade crossings on the inner tracks which renders the movement and succession of trains much more rapid. The third-rail system is used, conductor rails being placed outside the tracks at a height nine inches above the upper surface level of the running rails in the subway, while on the elevated section they are placed between the two tracks and two inches lower. This difference in height serves to operate a connection through an automatic contact which throws on the lighting circuit of the train when it goes into the subway. No less than five separate systems of conductors are installed, as follows: (1) For supplying current for working the trains; (2) for lighting the stations, switch and signal lights, carsheds and workshops; (3) for the safety signal installation; (4) for telephones; (5) for working the signals and switch points in the junction triangle where the tracks cross one another at different levels. The conductor rail is of steel, five and one-half square inches in cross-section, copper-bonded. On the sections near the power-house bare copper bar-feeders are also laid parallel with the conductor rail. The feeder conductors are rectangular and range from 1.5 to 2.3 square inches in area. The lighting mains for the stations are also bare and are laid beside the third rail. All of these conductors are supported on insulators attached to the track in various ways according to the nature of the permanent way. The third rail is protected by guard beams of wood projecting five inches above its upper surface level. The lighting mains carry 660 volts normal pressure, arc lamps burning from it in series circuits of twelve lamps each and 220-volt incandescent lamps being used in series of three where incandescent lighting is required. Regulation is effected by pilot wires which run back to the power-house. The running rails are used as one side of the lighting circuit as well as of the running circuit. Insulators for the feeders and other conductors are of the double-bell type, the outer portion being porcelain and the inner hard rubber. The trains at present consist of two motor cars with an ordinary car between them. The motor cars have a driving cab at one end only, the train being made up so that one cab comes at each end. The motors on each car are permanently connected in parallel, and in starting the motors of the two cars are connected in series and then in parallel. In braking, the motors are short-circuited.—*Elektrotechnische Zeitschrift* (Berlin), February 13.

Internal Resistance of Batteries.

The ascertaining of the true internal resistance of primary cells has occupied the attention of scientists for the last fifty years. The difficulty of obtaining accurate results which are not influenced by making the method of testing, is evidenced by the discrepancy between the conclusions of various experts. Mr. C. H. Ayres, Jr., has elaborated a new method of measuring this internal resistance, using alternating currents. In his introductory remarks he reviews the results of other experimenters who also used alternating currents, and who found that the variations in the internal resistance were considerably less than when ascertained by means of steady currents. For instance, Professor Kohlrausch found a value for the internal resistance which remained practically constant, while the value of the alternating current sent through was varied within wide limits. The author uses a modification of Kohlrausch's method, working with a metre bridge, and using a telephone as the indicator balance. He then inserts two condensers, one in the arm of the bridge containing the cell and the other in the variable resistance arm. Under ordinary conditions, the cell would be prevented from sending any current by the condenser in series with it. When, therefore, it is desired to measure the resistance, while the cell is sending current, it is necessary to shunt the same with a known resistance having no self-induction. With the arrangement as described, silence is obtained when

$$\frac{r_i}{r_2} = \frac{a}{b} = \frac{C_2}{C_1}$$

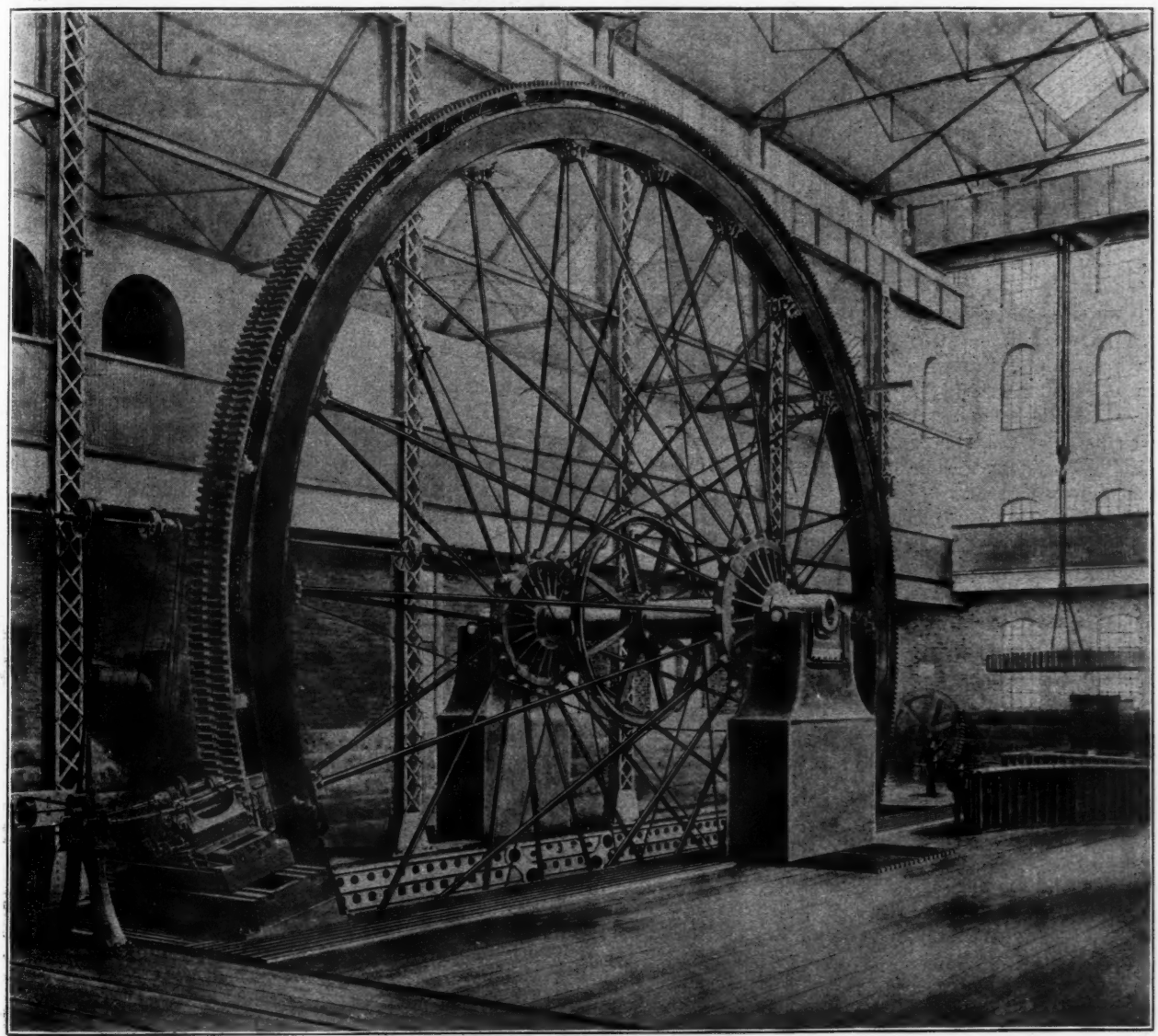
where r_i equals the internal resistance of the cell, r_2 the variable resistance; a and b are the lengths of each side of the metre wire from the slider, and C_1 and C_2 are the capacity of the two condensers. The author uses mica condensers of about thirty microfarads each. The operation in ascertaining the above conditions of silence was as follows: First, the slider was moved along the bridge wire until minimum noise in the telephone was heard; r_2 was then varied to improve the minimum, and then the slider again moved until silence was obtained. The author uses a small induction coil to give the alternating current.—*Physical Review* (London), February.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A Giant Sand-Wheel.

The Robert Poole & Son Company, iron founders and machinists, at Woodberry, Baltimore, Md., is finishing one of the largest wheels of its kind in the world. The wheel is known as a sand-wheel, and was ordered by the Calumet & Hecla Mining Company for one of its copper mines at Lake Linden, Northern Michigan, near Lake Superior. It is being built from the plans of the company's engineer, Mr. E. D. Leavitt, of Cambridgeport, Mass., and is sixty-five feet in diameter, weighing, with its base-plates and supporting columns, over 1,000,000 pounds. The shaft or axle is made of Krupp crucible cast steel, thirty-two inches in diameter, twenty-seven feet long, with a sixteen-inch hole bored through the centre, and weighs 42,000 pounds. The journals are twenty-five inches in diameter, forty-two inches long. Two gun-iron hubs are fitted to either end of the shaft, each weighing 20,000 pounds, and from these hubs radiate forty four-inch steel arms or spokes, which support the rim sections on the same principle as a bicycle-wheel; each spoke arranged with special nuts and threads for fine adjustment when erected in place. The rim is built up in twenty segments. It consists of two concentric rings, one on the inside for strengthening the entire structure attached to the radial spokes, and another on the outside consisting of a toothed-gear rim fastened to the inside rim with bolts and keys. On the periphery of the outside rim are cast staggered or stepped-gear teeth, these teeth being milled with special tools to an accuracy of one thousandth of an inch variation. The pitch of the teeth is 4.7 inches, each row of teeth being



GIANT SAND-WHEEL IN COURSE OF CONSTRUCTION, TO BE DRIVEN BY 750-HORSE-POWER ELECTRIC MOTOR RUNNING AT 150 REVOLUTIONS PER MINUTE, DRIVING THE LARGE WHEEL AT FOUR REVOLUTIONS PER MINUTE.

twelve inches wide, making an effective working face of twenty-four inches. There are twenty-six teeth in each segment, or a total of 520 in the entire wheel.

To each side of the sectional rim is riveted a rectangular plate iron box, carrying on its inner side 275 buckets, 550 in all, each bucket measuring four feet three and one-half inches by three feet four inches. The buckets are set at an angle, which, together with the peripheral velocity, prevents discharge until a horizontal position is reached near the top of the wheel, the distance across the face of the wheel when the buckets are fitted being about twelve feet. The lower part of the wheel dips into a shallow pit, into which the refuse from the stamp mills flows, and as it turns each bucket is filled with water, gravel or sand, and carried up to be discharged, at an elevation of about fifty feet, into a trough, where it is carried away by the water in sluiceways, the discharge being close to 75,000,000 gallons in twenty-four hours. The pinion, or small wheel by which motion is given to the large wheel, has twenty-three teeth in each row and is thirty-seven inches in diameter, accurately milled to match the large wheel, and is fitted to a shaft carrying on its outer end a mortise or wood-tooth wheel engaging with an iron pinion fitted on the motor-shaft.

The electric motor for driving is of 750 horse-power and has a speed of 150 revolutions per minute.

The large wheel makes four revolutions per minute, and the peripheral speed at the inner edge of the buckets will be about twelve feet per second.

It is expected that the wheel will require about thirty or forty gondola cars for its transportation.

New Telephone Apparatus.

The Moore Telephone System, which operates in the eastern part of Michigan, connecting with the lines of the Michigan Bell and also the independent network, is supplied with the apparatus built by the Moore Telephone Manufacturing Company, Caro, Mich. The illustrations show the telephone which is made for either bridging or series work and the appearance of the bottom of the keys when placed in the board. In Fig. 1 the receiver is multipolar. The switch is of hard-drawn copper, brass and bronze, no castings being used, and the generator for the ringing apparatus is fitted with either chain or cog gearing. The armature is made of laminated iron and copper with a steel shaft. The transmitter is placed on a universal arm. The woodwork is oak throughout. The transmitter arm is so arranged as to always hold the transmitter in the same position. It is enameled in black with all

FIG. 1.—TELEPHONES FOR EITHER SERIES OR BRIDGING SERVICE.

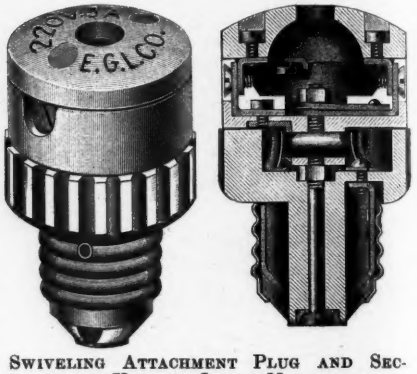
the trimmings nickel-plated. The Moore transmitter does not use granular carbon, but employs small balls. The face-piece is of turned brass, the diaphragm being of carbon. The repeating coil is fastened in the box with brass straps or sealed in paraffin wax if preferred, and is wound to any resistance. The drops and other switchboard apparatus are made especially for the requirements of small exchanges of 300 drops or less. These are very simple in construction, the shutters being very heavy, assuring positive night-bell connections. The coils are hand-wound.

There are eight contact springs on the listening and ringing key, all contacts being rubbing contacts. It will ring either plug and will discontinue when the lever is released.

These switchboards are made in sizes from 10 to 300 drops, the company making this range its special field of manufacturing.

A New Swiveling Attachment Plug.

Among the many improved forms of electric fittings and appliances which have been placed on the market during the past few years, it appears as if the matter of improving attachment plugs has been more or less passed over. Owing to their great convenience it has been necessary to use them, although they have not been included in the list of approved fittings by the fire underwriters.



SWIVELING ATTACHMENT PLUG AND SECTIONAL VIEW OF INSIDE MECHANISM.

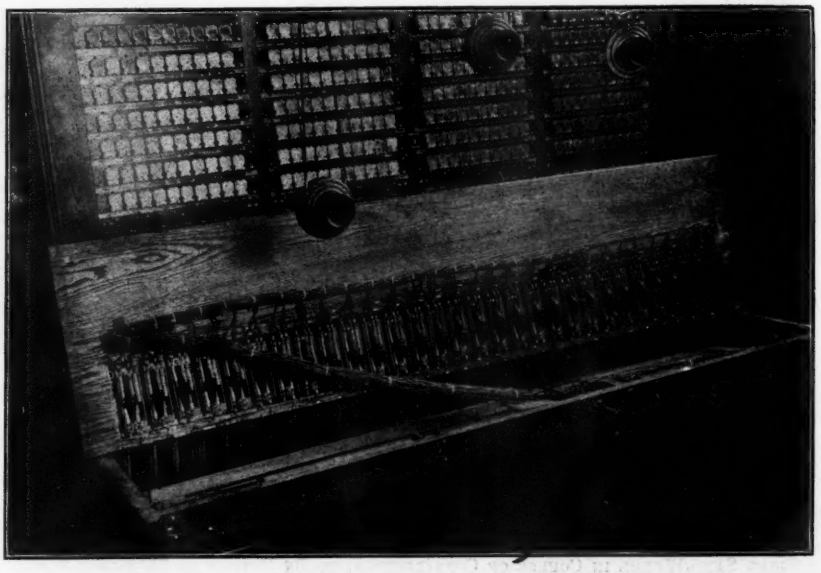


FIG. 2.—MOORE TELEPHONE APPARATUS, SHOWING BOTTOMS OF KEYS IN BOARD.

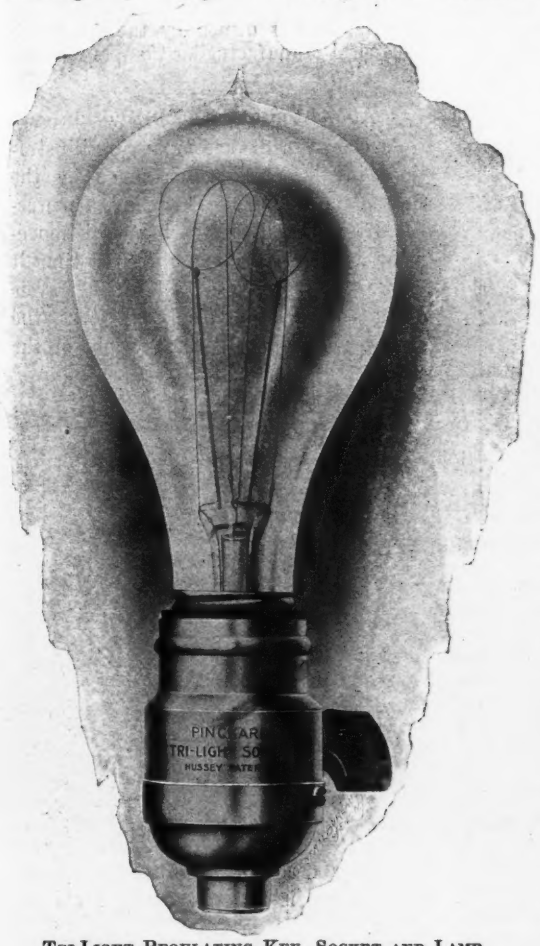
The attachment plug, which is shown in the accompanying illustration, is known as the "Howes" swiveling attachment plug and is made by the Electric Gas Lighting Company, of Boston, Mass. It is made all of porcelain, and the cord is

attached to the cap in the same manner as the old-style plug, but there is no fuse, as none is now required. The top portion should be held stationary so that the cord will not twist while the lower portion is screwed into the lamp socket or receptacle by turning the corrugated porcelain part with the thumb and finger of the other hand, thus avoiding the difficulty and trouble arising from a twisted and tangled cord.

The device is especially adapted for use with electric-heating apparatus where heavy cord is generally used, and is also of great advantage for use with flexible armored conduit, where, with the old-style attachment plug, difficulty has been experienced by reason of the untwisting of the plug and opening of the circuit due to the twisting of the conduit.

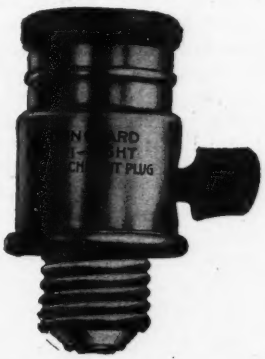
Three Lights in One.

The Pinckard "Tri-light," manufactured by the Tri-light Electric Company, Birmingham, Ala., gives three degrees of electric light from one incandescent lamp. No rheostat is used, consequently there is no danger of overheating the socket, and it is claimed that there is no waste of electric energy in useless heat.



TRI-LIGHT REGULATING KEY, SOCKET AND LAMP, COMPLETE.

The Pinckard socket resembles in appearance the ordinary incandescent lamp socket and is operated by turning the switch-key in the usual manner. At each turn of the socket key a different degree of light is obtained. This is accomplished through the ingenious construction of the socket contacts by which the connections of the lamp filaments are varied. In operation an incandescent lamp, whose maximum candle-power is sixteen, is fitted with two filaments of eight candle-power each. Turning the key of the socket once throws these two filaments in circuit in series giving a light of about two candle-power. A second turn of the key throws a single filament in circuit giving eight candle-power. A third turn of the key throws both filaments in circuit giving six candle-power. By turning the key the fourth time both filaments are thrown out of circuit and the light is extinguished.



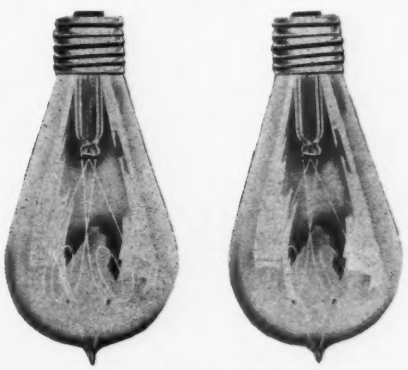
TRI-LIGHT REGULATING SOCKET AND ATTACHMENT PLUG.

These lamps are manufactured for maximum candle-powers of 8, 10, 16, 32, 50 and 100. Any standard Edison base lamp can be used with the Tri-light socket. Tri-light lamps can be used with any standard Edison socket, one filament only giving light.

For use with keyless sockets holding lamps in unhandy places the Pinckard regulating switch is supplied. This is shown in Fig. 2. This accomplishes the same results and in a similar manner as the Pinckard socket. For use with lighting installations already equipped with ordinary sockets, the Pinckard attachment plug is provided. This is screwed into the existing socket just as an incandescent lamp would be. The attachment plug is made with Edison, Thomson-Houston or Westinghouse base.

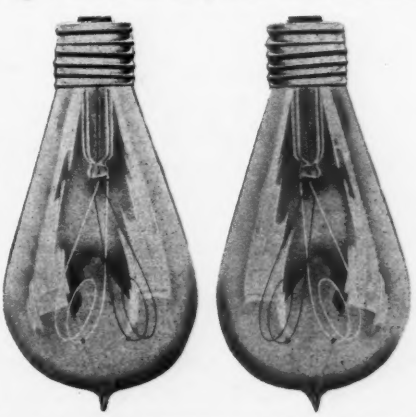
A New Regulating Incandescent Lamp.

The accompanying illustrations show the different conditions of the filaments in the "Star" regulating lamp manufactured by the Standard Electric Manufacturing Company, Niles, Ohio. This lamp, the maker claims, reduces the cost of light eighty-five per cent, is made in any candle-power and gives three degrees of illumination, taking current only in proportion to the light produced. The light is regulated by simply turning the bulb.



FIGS. 1 AND 4.—SHOWING FILAMENTS BURNING BRIGHTLY AT SIXTEEN CANDLE-POWER AND DIMLY AT TWO CANDLE-POWER.

Fig. 1 shows both filaments burning brightly at sixteen candle-power. A turn to the right turns down the light, as is shown in Figs. 2 and 3 which have the left and right filaments burning brightly with the right and left filaments out, respectively, and burning at eight candle-power. Fig. 4 shows the lamp with both filaments burning dimly and giving about two candle-power of light.

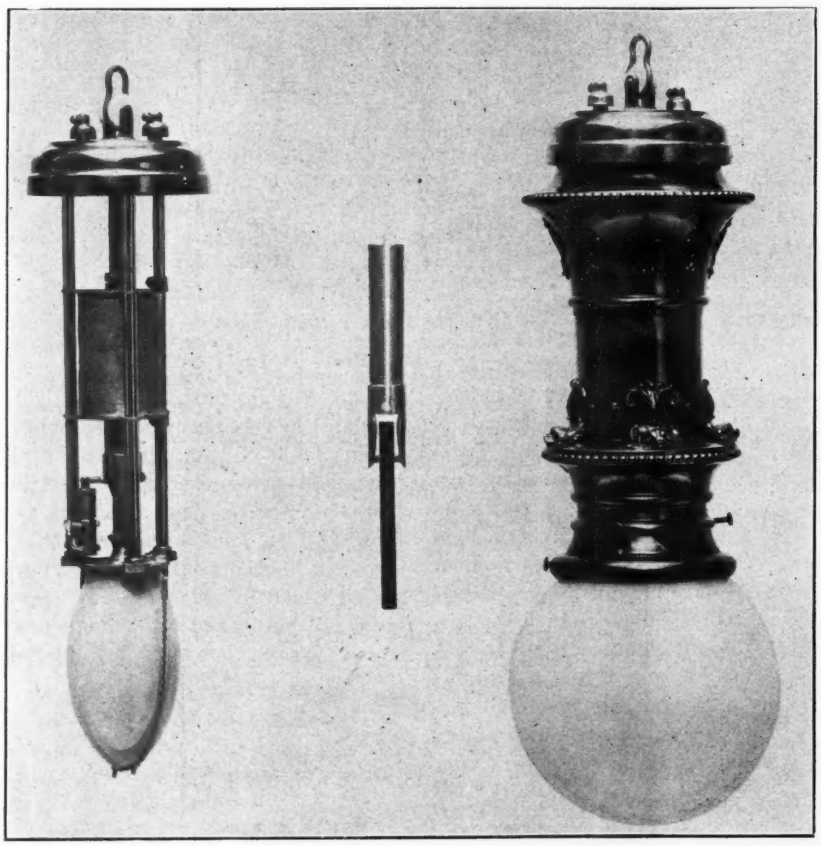


FIGS. 2 AND 3.—SHOWING LEFT AND RIGHT FILAMENTS BURNING AT EIGHT CANDLE-POWER.

The maker claims that when this lamp is turned very low it gives a satisfactory light and is highly advantageous for hospitals, hallways and the sick-room. The lamps are always made with two standard filaments, consequently having a double length of life. At the low light it has a remarkable length of life.

The Heany Enclosed Arc Lamp.

In the arc lamp shown in the accompanying illustration and described below, the inventor, Mr. J. Allen Heany, Philadelphia, Pa., claims to have accomplished the nearest approach to simplicity of mechanism, steadiness in burning, reliability, smallness in size and lightness in weight that has yet been attained. This lamp has stood the most severe examination under practical tests by the most prominent experts of this country for the last year, and has borne out with singular success the claims made by its sponsors. The lamp is supported on three tubes running its entire length. The tubes are held at the top by a casting and at the base of the lamp by a stamping.



IMPROVED ARC LAMP, SHOWING EXTERIOR APPEARANCE OF LAMP, SECTIONAL VIEW AND MAGNETIC CLUTCH.

The solenoid coil is held and supported by three tubes, provision being made to elevate or lower the coil in order to adjust the lamp for the amount of current it is to take.

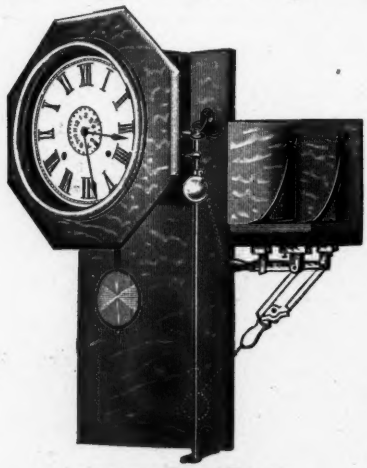
Running from the top of the lamp to the base and within the supporting tubes is placed another tube. This tube carries the upper carbon and also a flexible bond and holder. This assures a positive contact and prevents arcing, which generally results where sliding contacts are used, causing oxidization of the metals. Surrounding this carbon-carrying tube are placed the solenoid core and clutch combined. This core consists of two semi-tubular members, pivoted or hinged together and arranged to slide up and down on the carbon-containing tube. Each member is so constructed as to contain projections on the lower part adapted to make contact with the upper carbon. This projection traverses the wall of the tube containing the carbon, that when the solenoid core is energized the members will be made like poles and a repulsion take place, throwing the lower jaws inward, causing both jaws or projections to grip the upper carbon and at the same time to respond to the action of the coil and advance it in an upward direction, taking the carbon with it, resulting in establishing the arc. At the base of the lamp and supporting the carbon-carrying tube is a tapered piece which acts as a spreading device for the core. When the carbons are consumed to such a degree that it is necessary for the lamp to feed, the jaws come in contact with the tapering piece and are compelled to open, rendering the carbon absolutely free and eliminating any possibility of sticking.

The solenoid coil contains less than a pound of wire and is so wound that in case the arc should be cut out or the lamp short-circuited that the coil would not be broken down. The coil is wound in a special way so that in event of a dead short-circuit nothing short of the actual fusion of the copper wire could destroy it.

The total weight of the lamp is less than five pounds, and it will accommodate the regulation size carbon of twelve inches with less than eighteen inches in the length of the lamp. It may be readily adjusted to burn on any desired amperage. The possibility of parts sticking or getting out of order is reduced to a minimum as there are only two movable parts. This does away with many objectionable features, due to the elimination of the mechanical clutch which is in every other lamp, and is attended with numerous joints, levers and springs, the substitution of which in the Heany lamp is the clutch and core in one piece, and this is operated entirely by magnetism. From the construction of the clutch it is rendered possible to have a wide range of deviation in the diameter of the carbon, at the same time not affecting its clutching properties. Connected to the hinge portion of the core is a projecting arm, pivotally connected to the dash-pot, which is connected to one of the main supporting rods with a clamp. This construction enables the easy removal of the dash-pot. This simple and ingenious lamp is the invention of J. Allen Heany, of Philadelphia, and is owned by the American Electrical Manufacturing Company of the same city.

An Automatic Clock-Switch.

As shown in the accompanying illustration, in the clock-switch made by the Baird Manufacturing Company, a powerful fifteen-day double-spring clock movement is used, and at any desired time it trips off a heavy iron ball which travels on a rod and in dropping jerks the switch wide open. As the weight of the ball after descending still pulls on the switch there is no opportunity for a rebound.



AUTOMATIC CLOCK-SWITCH.

There is no possibility of the switch forming an arc as but two contingencies are possible. First, if the clock should through any means fail to trip off the ball the switch contact remains positively closed. Second, if the ball drops, its heavy weight is bound to throw the switch wide open.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

ENGLISH ELECTRICAL TRANSACTIONS OPPOSED—The electric traction schemes in Nottinghamshire and Derbyshire, England, have met with the opposition of the established railway lines, according to United States Consul McFarland's report just received by the State Department. The result is, the consul says, that the several plans have been withdrawn and the promoters have submitted the matter to Parliament. It is stated that American capital and equipment to the extent of at least $5,000,000 were intended to figure in these projects.

A SWISS ELECTRIC POWER SCHEME—A scheme to utilize the mountain torrents of the country for industrial electric power is about to be projected by the City of Zurich with the cooperation of Cantons Schwytz and St. Gall. The Marsby Valley behind Einsiedeln, once a site of a lake eleven miles square, is again to be converted into a lake by means of water from the torrents of Grossbach, Reichenbach and Sihl. The huge fall will give a force equal to 60,000 horse-power as the difference between this valley and that of Lake Zurich is about 600 feet. The work will cost about $7,200,000.

ELECTRIC LIGHTING COMPANIES FORM IN COMBINATION — The Northern California Power Company has been formed with a capital stock of $2,000,000 to absorb the Keswick Electric Power Company, Redding, Cal., the Redding Electric Light and Power Company, the Redding Water Company, and the Tehama County Electric Light Company, of Red Bluff. The new company will soon have its wire down the Sacramento Valley as far as Willows, Glenn County, and will later reach further down the valley for business. The company will increase the present plant of the Keswick Electric Power Company on Mill Seat Creek, where at present there is machinery for the creation of 3,000 horse-power with available water right for the creation of 12,000 horse-power.

LIGHTING AND POWER COMPANIES TO COMBINE—The details of the merging of several water power and lighting companies in the immediate vicinity of Grand Rapids, Mich., have been completed and important developments as to light and water-power conditions are to be expected. By the terms of the combine it is announced the old Grand Rapids Electric Light and Power Company, the Edison Light and Power Company, the Muskegon Water Power Company, the West Michigan Electric Company, Lowell Water and Heating Company, and the Peninsular Light, Power and Heating Company are all merged under one management. The capital stock of the new company will be $1,500,000, including about $400,000 of the Edison stock, $100,000 in the Lowell concern and $50,000 invested on the Muskegon River.

RUBBER COMPANY IN PERU—The secretary of legation at Lima, Mr. Neill, under date of February 19, 1902, reports the formation of a rubber company in that city with a capital of £26,000 ($126,529) to operate in the province of Sandia, Department of Puno. Another company, Mr. Neill is informed, will take possession of 50,000 hectares (123,550 acres) of land near Marcapata, to exploit the rubber thereon. It is also reported that an individual has acquired some good rubber lands in the same neighborhood, and some 500 pickers are already working and getting about 100 pounds per month. The "denouncing," adds Mr. Neill, costs little, although the measurement of the concessions is expensive. To measure 30,000 hectares (71,130 acres) costs about £1,000 ($4,870). It is believed that rubber is destined to become a most important source of wealth to Peru.

RAILWAY CONCESSION IN SALVADOR—A concession has been granted to Mr. José Cabezes Bonilla, of Costa Rica, for the completion of the railway from La Union to San Miguel, the construction of a line from San Miguel to San Salvador, and the construction of a pier of steel and iron in the port of La Union. The management binds itself to make necessary repairs on the part already constructed, to commence work five months after the contract is declared legal and to have it constructed and open for traffic in fifteen months after commencing. Steel rails are to be used and the sleepers of good timber preferably of the country. The motive power shall be steam, but electricity or any other motive power, except animal, may also be used subject to the approval of the government. The machinery, materials and other articles necessary for the construction, operation and maintenance of the railroad, pier, and a lighthouse which the company has also contracted to build, shall be imported free of all duties and imposts.

MOTOR BOAT EXHIBITION AT BERLIN—On the first of June next there will be opened at Wannsee, a watering-place station on the Havel, a few miles west of Berlin, an international exhibition of motor boats and all that pertains to their construction, use and maintenance. The enterprise is projected under the auspices of the Middle European Motor-Carriage Association and the committee of initiative, which has its office at No. 1 Universitäts Strasse, Berlin, has for its president, Count von Talleyrand-Périgord, and is made up of well-known men of the highest position and responsibility. The exposition will also have the powerful support of the Emperor of Germany. The plan of the association contemplates a practical competitive international display, which is intended to bring together in friendly competition the best that has been achieved in all countries in respect to the construction, care and use of boats, launches, yachts and other craft of moderate tonnage and propelled by gas, gasoline, electrical or steam motors. An elaborate schedule of competitions in speed, endurance, economy of fuel, etc., for the separate classes of motor boats is in preparation and will be carried out under the supervision of expert judges during the exposition, which will continue from June 1 until late in the summer.

TELEPHONE AND TELEGRAPH

KEARNEY, NEB.—A new telephone company has been started with a capital of $10,000 and will be known as "The Farmers' Home Telephone Company." It is composed of the farmers in Shelton and Gibbon townships and will begin operations at once. The incorporators are William Smith, Albert Allen, Jacob Stearley, W. H. Maurer and Joseph Buck, Jr.

BUTTE, MONT.—H. H. Stewart, president and general manager of the People's Telephone Company, which will establish a new system in Butte, has returned from a business trip East. While in the East Mr. Stewart purchased wire, cables, switchboard and all of the electric apparatus necessary, and as soon as the frost is out of the ground the line construction will begin.

NASHVILLE, TENN.—Ten independent local telephone companies, operating at and between Carmi, Ill., and Metropolis, Ill., in counties along the Wabash and Ohio rivers, have made arrangements with the Cumberland Telephone and Telegraph Company to become sublicencees, substituting for their instruments and switchboards standard Bell apparatus, in this way getting direct connections with the entire long-distance telephone system.

LARNED, KAN.—The Larned Telephone Company has begun the work of extending a long-distance line east to connect with Great Bend and Ellinwood. A wire will also be strung along the line of the Missouri Pacific to Ray and Stafford, while another line will be run to Rozel, Burdett and Jetmore. The Larned company will build westward to Garfield and Kinsley. This will give Larned people a long-distance connection with all towns along the line in every direction.

FRANKLIN, IND.—There is much activity in Johnson County in the telephone business. Independent companies have been organized in the last month at Whiteland, Greenwood and Morgantown, and they are building lines into the country that the farmers may have the service. The organization of a company at Trafalgar is talked of. Lines from Franklin now reach almost every hamlet in the county. Nearly all the lines are operated by home people. There are 1,000 telephones in the county, and the number is increasing as rapidly as the companies can fill the orders.

FREDERICKSBURG, VA.—A telephone line will probably be erected between this city and Tappahannock some time this year. The matter has been agitated, and citizens of Essex and other localities between the two points have subscribed. Fredericksburg will be asked to subscribe to the enterprise, and the mercnants of the city will no doubt substantially aid the movement when they are called upon. Citizens of Stafford have determined to build a telephone line between this city and Tackett's Mill in Upper Stafford, a distance of twenty-five miles. Work will begin on it as soon as the spring opens, and it is expected that the line will be later extended to Warrenton.

ELECTRIC RAILWAYS

CHICAGO, ILL.—Messrs. P. A. Widener and William L. Elkins, it is reported, have purchased the Old Dominion Street Railway Company, of Norfolk, Va., for $450,000.

THOMPSONVILLE, CT.—The survey of the proposed new trolley route to Sommerville has been completed; the line runs almost directly east through Hazardsville and Scitico. Work will be begun very soon.

ALBANY, N. Y.—The New York City Interborough Railway Company has been incorporated with a capital of $400,000 to operate a street surface railroad about forty miles long.

ELWOOD, IND.—The project of building an electric line between this city and Fortville, twenty-five miles to the south, has been renewed and there are strong indications that it will be carried out successfully.

SANTA MONICA, CAL.—Ground has been broken for the rebuilding of the horse-car line along Third street from Oregon avenue to Utica avenue, and along the latter thoroughfare to Ocean avenue as a trolley road.

LA GRANGE, ILL.—The Chicago & Joliet electric road will commence the construction of its branch to Lyons and La Grange early next month. It is understood that a subway is contemplated under the Alton tracks and that it will enter Lyons through the property of Fred Schultz.

UNIVERSITY, CAL.—The contract for the grading of the road-bed for the Redondo Railway Company's new electric line to the sea has been let, and work thereon will be pushed as rapidly as possible. It is expected that the road will be in operation in the early part of the summer.

VERSAILLES, KY.—W. S. Longee, of Cleveland, Ohio, has applied for a franchise to build an electric railroad through Versailles from Lexington to Frankfort. The council recently granted a similar franchise to the Bluegrass Traction Company, which objected to some of its provisions, and has not accepted it.

HAGERSTOWN, IND.—The seven miles of track between Hagerstown and Cambridge City of the Whitewater Valley Railroad will be abandoned by the Big Four. It is reported that a portion of the line will be turned into an electric railway to connect with the Indianapolis-Richmond line now being constructed.

MARION, IND.—The Marion & Goshen Street Railroad Company, of North Manchester, has been incorporated with a capital of $10,000. The company intends to operate a system of street railway and interurban lines between Marion and Goshen, connecting Marion, Wabash, North Manchester, Warsaw and Goshen.

UTICA, N. Y.—Practically all the grading for the Utica-Herkimer street car line is finished, the bridges are being built and the road is almost ready for use. It is expected the line will be in operation by July 1. General Manager Stanley is in Cleveland, where he attended the reorganization of the consolidated street railways of that city.

LOGAN, UTAH—Mr. E. A. Lachner, of the Telluride Power Company, has made application to the county commissioners for a franchise to build an electric trolley line from Ogden, east through Ogden Canon and Ogden Valley, touching all the towns in that direction and all those of the southern part of Cache Valley to Logan.

SOUTH LYON, MICH.—An electric railway for this village appears to be something more than a possibility. A meeting has been held here at which C. C. Yerkes, of Northville, talked on the railroad company's proposition, right of way, etc., and a committee from South Lyon afterward arranged to meet similar committees from Northville and Brighton to discuss the matter farther. The proposed road will be an extension of the Northwestern running from Northville to Brighton by way of South Lyon.

ROYERSFORD, PA.—The route of the Royersford Electric Railway between Royersford and Collegeville, has practically been determined upon and the consent of property owners along the proposed route has nearly all been secured. Work upon the line is to be begun as soon as the weather permits. The original project to run a spur into Phœnixville, which has been interfered with by the refusal of the commissioners of Montgomery and Chester counties to permit the company to lay its tracks over Black Rock bridge, has not been entirely abandoned, and an independent bridge over the Schuylkill may be erected.

JERSEY CITY, N. J.—The North Jersey Street Railway Company has formulated plans for extensive improvements and changes in its system, a part of which calls for a belt line seventeen miles long, and connecting the terminal at the Pennsylvania Ferry, in Jersey City, with Bergen Point, Bayonne. Another improvement contemplated by the company, and which will form a link of the proposed belt line, is the extension of the West Side Avenue trolley line south from its present terminus in the West Bergen section to Seaview avenue.

NEW INCORPORATIONS

DETROIT, MICH.—The Cooperative Telephone Company. $250,000.

GLASSBORO, N. J.—Sweeten & Purvis Electric Light, Heat and Power Company. $100,000.

SPRINGFIELD, ILL.—Farmers' Mutual Telephone Company. $5,000. Incorporators: M. E. Harshberger, E. E. Lesch, J. E. Duggan.

GRINNELL, IOWA—Long-Distance Cipher Telephone Company. $500,000. Incorporators: C. R. Morse, C. W. Beyer and C. H. Brown.

MADISON, WIS.—Tomah Electric and Telephone Company. $25,000. Incorporators: Charles W. Croty, William B. Naylor, Jr., and Edward E. Schwerer.

WILMINGTON, DEL.—Harrington Water and Light Company, of Reading, Pa., to establish a water and electric light plant at Harrington, this state. $20,000.

LEESBURG, VA.—Loudoun Electric Light and Power Company. Directors: Dr. Joseph M. Fox, S. S. Lutz, E. B. White, N. S. Purcell and Beverley B. Chichester.

SHELTON, NEB.—The Farmers' Home Telephone Company. $10,000. Incorporators: Wm. J. Smith, Albert Allen, Jacob Stearly, W. H. Maurer and Joseph Buck, Jr.

COLUMBUS, OHIO—The Clinton Telephone Company, a Delaware corporation. $50,000. To do business in Ohio. Headquarters will be at Wilmington, Clinton County.

DOVER, DEL.—Dillen Electric Light Company, to construct an electric light plant at Dillen, Beaver County, Pa. $100,000. The incorporators are from New York city.

HELENA, MONT.—West Gallatin Telephone Company. $10,000. Incorporators: E. C. Kinney, E. B. Martin, W. L. McDonnell, John McDonnell, J. D. Huffine, E. M. Ferris and A. L. Love.

GUTHRIE, OKLA.—The Farmers and Business Men's Telephone Company, of Carwile. $10,000. Incorporators: J. H. Madaris, O. A. Brewer, Guy T. Johnson, J. B. Vandyne and C. M. Brewer.

MADISON, WIS.—Iowa & La Fayette County Farmers' Telephone Company, Fayette, La Fayette County. $10,000. Incorporators: T. J. Van Matre, E. D. Parkinson, T. B. Andrews.

DENVER, COL.—The Guanajuato Power and Electric Company. To operate in the republic of Mexico. $3,000,000. Incorporators: Leonard E. Curtis, Henry Hine and Irving W. Boutright. Offices in Colorado Springs, Col.

AUSTIN, TEX.—Texas Telephone Company, of Texarkana. $150,000. Incorporators: F. M. Marriott, of Delaware, Ohio; W. P. Harrison and Fred E. Harrison, of Cincinnati; E. J. Eubanks, of Columbus, and others.

LAWTON, OKLA.—The Comanche Light and Power Company. $50,000. Incorporators: M. M. McGregor, of Wichita Falls, Tex.; W. H. Anderson, George W. Bore, F. M. English, George M. Parchals, of Lawton.

DOVER, DEL.—The American Lighting Company, Limited, of Wilmington, Del.; $134,000; to contract for public and private lighting. The Tennis Bros. Company, of Pittsburgh, Pa., to promote and sell electric railways and do general construction business; $100,000.

INDIANAPOLIS, IND.—The Perry County Home Telephone Company to operate in the following Indiana counties: Perry, Spencer, Warrick, Vanderburg, Dubois, Crawford, Harrison and Floyd. $25,000. Directors: Gustave Meyer, Andrew Steinhauer, Edward Harrer and Oscar C. Minor.

BIRMINGHAM, ALA.—The Central Light and Power Company, of Ensley. $50,000. Incorporators: W. T. Terry, R. F. Wells and Henry Broda, of Ensley. The company will build an electric light and power plant and will also manufacture gas and sell electricity and gas for heating.

SPRINGFIELD, ILL.—Western Illinois Traction Company, Monmouth; to operate street and interurban railways; $10,000; incorporators: W. M. McCullough, W. B. Young and S. S. Hallam. The Harvard Electric Company, Chicago, certified to an increase of capital stock from $10,000 to $50,000.

ELECTRICAL SECURITIES

Irregularity of price fluctuations and strictly professional dealings marked speculation during the short week of four business days, the exchanges having been closed Friday and Saturday, due to the Easter holidays. At the beginning of the spring season, attention naturally turns to a comparison of the state of affairs in the financial world at present with that which existed a year ago. Considerable change is evident today. There is great caution, and apparently calmness, instead of the fever of speculation which existed in April, 1901; the speculative public, that is the public which takes an interest in the market, by times, is still showing a very great apathy, the commission houses reporting a very great decrease in the profits for some time past; however, there is no worried or timid feeling extant or any sign of an immediate approach of danger. For a time it looked as if the coal trade prosperity would be interfered with seriously by the menacing attitude of the Anthracite miners. This would of course react disadvantageously upon other industries. There is no immediate prospect of this trouble now that the Civic Federation has secured the deferment of any positive movement for at least a month. It is expected that possibilities of any dispute will be effectually removed, as all parties interested are making great efforts to come to some satisfactory agreement. Trade returns of the general prosperity, along with railroad earnings, are exceedingly gratifying. The prosperity of the iron and steel trade is remarkable, and as this has a great deal to do with the appearance of stability of the market in general, there seems to be little encouragement for bear sentiment in any direction.

ELECTRICAL SECURITIES FOR WEEK ENDING MARCH 27 (Exchanges closed 28 and 29).

New York:	Closing.
Brooklyn R. T.	64¾
Con. Gas	225¼
Gen. Elec	322
Kings Co. Elec	196
Man. El	133½
Met. St. Ry	167¼
N. Y. & N. J. Tel. Co	168
Telep., Tel. & Cbl. Co	5
Westinghouse Mfg. pf	195

The break in General Electric during the week from 323½ to 319 was on selling in the endeavor to take profits, the sales being evidently induced by the failure of the directors of the company at their meeting to take any action looking to an increase in the capital stock of the company. This has been talked of for some time with anticipations for incidental rights to stockholders. It has been reported, however, that the matter of a stock increase will most certainly be taken up at the annual meeting in May.

It has been decided to go ahead with all details of the plan in which the Metropolitan Securities Company, the holding company which has been formed to take over the lease of the Metropolitan Street Railway Company, is involved, but nothing will be done in contravention of the injunctions now pending.

Boston:	Closing.
Am. Telep. & Tel	174
Edison Elec	270
Mass. Elec. pf	97
New England Tel	146
Western Telephone & Telegraph	94½

American Telephone was one of the leaders in the Boston market during the week, bidding up to 174 and closing at that figure. Local financiers believe that this stock will see still further advances.

The New England Telephone and Telegraph Company has declared a regular dividend of 1½ per cent, payable May 15.

Philadelphia:	Closing.
Elec. Co. of America	7¾
Elec. Stor. Bat. c	74¼
Elec. Stor. Bat. pf	74¼
Philadelphia Elec	5
Union Traction	41
United G. I. Co	121¾

Union Traction sold up to 41, the highest since December, 1899. Philadelphia Traction, Electric Company of America and Electric Storage Battery were also higher.

At a meeting of the directors of the Electric Company of America, held in New York, no business was transacted other than the organization and the election of officers, the old officers being reelected. One of the directors is quoted as saying that the company's prospects were never brighter and that it was expected that a large increase in the volume of business handled during the year and a proportionate gain in net receipts would be shown.

Chicago:	Closing.
Central Union Tel	40
Chicago Edison Light	175
Chicago Telep	185
Metropolitan El. pf	91⅝
National Carbon	25
National Carbon pf	90
Union Traction	19½
Union Traction pf	50½

President Roach, of the Union Traction, and W. W. Gurley, general counsel, on their return from New York during the week, made a statement to the effect that there was no change in the situation of the Sutro Brothers suit to set aside the purchase of the Consolidated Traction Company. The application of the Union and the Consolidated Traction companies for an injunction to prevent the collection of $400,000 taxes was denied by Judge Tuley.

OBITUARY NOTICE

MR. DANIEL H. DARLING, who was president of the United States Storage Battery Company, died suddenly on March 26 in a New York & New Haven train in the Grand Central station. He had left his office during the afternoon and was on his way to his home in Rye. Mr. Darling had been ill for six months and his last visit to town was for the purpose of getting his business affairs in shape prior to going on a two months' trip to Florida. Mr. Darling was fifty-seven years old and was born in North Adams, Mass. Most of his life had been spent in the banking business. He was a member of the Boston Stock Exchange and of the Montauk, Hardware, and New York clubs.

ELECTRIC LIGHTING

LYONS, COL.—At a recent meeting of the city council a twenty-year lighting franchise was granted to Mr. George M. Gillmore, of Denver.

WAUKESHA, WIS.—The common council has passed over the Mayor's veto the twenty-year franchise to the Waukesha Electric Light Company.

BLOOMSBURG, PA.—A new company is being organized for the purpose of generating current for lighting, heat and power. A charter will soon be petitioned for.

YOUNGSTOWN, OHIO—The offices of the Youngstown Gas and Consolidated Light Company have been moved to the Park Theatre Building on South Champion street.

LIVINGSTON, MONT.—The Electric Light, Water and Power Company at Jardine is making preparations to install a plant by which the town, stamping mills and mines will be furnished with light, water and power.

NEWARK, N. J.—The Commercial Electric Company has been incorporated in this city with a capital stock of $100,000, of which $5,000 has been paid in. The object of the company is to make and sell electrical plants for generating light by means of steam, gasoline or hydrocarbon engines.

PEKIN, ILL.—The Pekin Light, Heat and Power Company has changed its name to the Citizens' Gas and Electric Company. The company has been organized under the laws of Wisconsin. The old bonds of $100,000 have been liquidated and bonds for $150,000 have been issued. Of this sum $50,000 will be a reserve for the betterment of the plant.

MULLICA HILL, PA.—The Glassboro & Clayton Electric Light Company will shortly extend its lines to several other Gloucester County towns. The Harrison township committee has an ordinance under consideration, granting the company the privilege of extending its lines from Alcyon Park to Richwood and Ewan, *via* this place.

BINGHAMTON, N. Y.—The Binghamton Light, Heat and Power Company, which has recently purchased much of the property of the Binghamton General Electric Company, is considering plans to greatly improve the electric light and power service in Binghamton. Additional boilers, new dynamos and a special switchboard will be installed.

SAN RAFAEL, CAL.—A contract has been signed between J. A. McNear, owner of the summer resort at Point San Pedro, and the California Central Gas and Electric Company for the stringing of wires between San Rafael and Point San Pedro for the furnishing of light and power to the latter place. For some time it has been current rumor that after the installation of electric power on the line of the North Shore Railway an electric line would be built from this place to Point San Pedro and the latter spot be extensively built up as a summer resort. The contract entered into by McNear and the corporation would appear to indicate that there is a strong foundation of fact in the rumor, and early developments are expected.

INDUSTRIAL ITEMS

THE CHARLES E. DUSTIN COMPANY, New York city, has issued a new bulletin descriptive of street railway apparatus which it has on hand for immediate delivery.

THE CRESCENT BELT FASTENER COMPANY, New York city, illustrates and describes in a handsome catalogue of forty-eight pages a very complete line of patent belt fasteners.

BULLOCK ELECTRICAL MANUFACTURING COMPANY, Cincinnati, Ohio, has issued the April number of its historical series of great men of science and engineering. This is descriptive of Hermann L. F. Von Helmholtz.

THE HUNTER FAN AND MOTOR COMPANY, Fulton, N. Y., has recently shipped a large supply of its ceiling-type alternating-current fan motors to China. The company reports a large export business.

GEORGE WEBSTER, Christiana, Pa., manufacturer and patentee of dishorners and cord adjusters, makes a specialty of the Diamond cord adjuster. Mr. Webster has splendid facilities for supplying promptly orders of any magnitude for this material.

THE GENERAL INCANDESCENT ARC LIGHTING COMPANY, New York city, is sending out a large postal card bearing monthly calendars, including March and August. The suggestion is that "time flies, and so does your opportunity to order this season's stock of fans."

THE CHARLES WARNER COMPANY, New York city, Wilmington, Del., and Philadelphia, Pa., is introducing a new building material known in the market as "Limoid." Although of comparatively recent introduction, a wide use has already been created for this product.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., in circulars No. 125 and No. 126, describes the S. K. C. system of condensers and the voltmeter compensator and voltophone. These bulletins contain full information as to methods of installation, sizes and price.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing among its customers attractive pamphlets, descriptive of the Wurts and Garton lightning arresters. Those interested can obtain this printed matter upon request from the above company, which will also be pleased to quote prices.

J. J. JONES & SON, New York city, manufacturers of and dealers in general electrical supplies, have issued a new catalogue. This catalogue contains 174 pages, is profusely illustrated and includes a comprehensive index, appearing to cover everything needful in electric lighting installations.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., is placing the Benbow telephone bracket on the market. This is made of polished and oxidized copper throughout, is ornamental and is effective in keeping the telephone out of the way when not wanted, but having it at hand when necessary.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, with offices at New York, Philadelphia and Chicago, is advertising the Jandus enclosed arc lamps and electric fans with a highly colored desk blotter, which is further illuminated by three rushing horses drawing a chariot with the leading inscription "first in the race."

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., has established itself as the western repository for many of the standard makes of wires. It has in Chicago stock for immediate shipment a full supply of Roebling's and American Steel and Wire Company's Extra B. B., B. B. and special galvanized steel telephone wire.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has issued Bulletin No. 7. This is a handsome catalogue printed in two colors, containing 48 pages and cover. Numerous half-tone illustrations combined with complete information as to descriptions of apparatus and code words make this very desirable to all users of telephone apparatus.

THE MCGUIRE MANUFACTURING COMPANY, Chicago, Ill., manufacturer of controllers, charging rheostats, field regulators, speed regulators, motor starters, theatre dimmers, and rheostats to any specification, is favoring its patrons with a handsome calendar which is beautifully embellished with a reproduction in natural colors of a starting apparatus.

THE STIRLING COMPANY, Chicago, Ill., reports a good demand for its water-tube safety boilers. There is over a million in horsepower of these boilers now in use. The boilers are of wrought metal throughout, and have no flat surfaces or stay-bolts; four manholes give access to every tube, and quick and steady steam and thorough circulation are guaranteed.

THE CINCINNATI MILLING MACHINE COMPANY, Cincinnati, Ohio, has just issued a new 1902 catalogue showing its new lines of milling machines. This is a handsome piece of bookwork, the numerous illustrations being in half-tone throughout. A number of interesting improvements are described in detail, among these, the new all-gear feed mechanism, whereby all feed changes are instantly obtained by the movement of the lever, the drive being always positive, permitting much heavier and faster cuts than on the old belt-fed mechanism.

THE NORTHERN PACIFIC RAILWAY has prepared a handsome souvenir, being the latest of a series of "Wonderlands" that has attracted increasing attention from year to year. Beautiful half-tone illustrations adorn every page and the letter-press is descriptive of such subjects as the "Moraine of the Glacier," "Mining in Montana," "Two Thousand Miles Through Story-Land," "Among the Cheyennes," "Geyers, Canons and Wild Animals," "Puget Sound and Alaska." The book is printed for general distribution and can easily be obtained by sending to Charles S. Fee, St. Paul, Minn., six cents in postage stamps, together with the proper address.

THE MICA INSULATOR COMPANY, New York, Chicago and London, is now putting on the market its well-known empire brand of oiled cloths and papers in rolls of 50, 100 and 500 yards length; also being prepared to furnish it in any length desired. An entirely new and original process enables the manufacturer to coat the material with two very evenly distributed coats of pure linseed oil. Experience has proven that pure linseed oil refined and treated by the Mica Insulator Company process is excellent as a coating for cloths and papers. Empire cloth will retain its high finish and rubber-like flexibility indefinitely and may be kept in stock a long time without any deterioration either mechanically or electrically. It is thoroughly dried before leaving the factory, and does not contain nor does it need any wax paper between the sheets to prevent them from sticking together. The manufacturer will be pleased to furnish samples, circulars and prices to any who may be interested.

PERSONAL MENTION

MR. J. E. FARNSWORTH has been appointed general manager for the Arkansas and Texas division of the Southwestern Telegraph and Telephone Company.

MR. ROBERT MCF. DOBLE, consulting engineer, of San Francisco, Cal., is in Mexico engaged in the examination of hydro-electric transmission projects in the interest of eastern capitalists.

MR. CHARLES H. BRISTOL, superintendent of construction of the Western Division, has been appointed general superintendent of construction of the Western Union, with headquarters at New York.

MR. J. C. BARCLAY, electrician of the Western Division, has been appointed electrical engineer of the Western Union Telegraph Company with headquarters at New York. The appointment is to take effect on April 1.

MR. W. R. FABEN, managing director of the Owosso & Corunna Electric Company, has resigned to accept a position with the Hammond Illuminating Company, of Hammond, Ind. He will have charge of the extensive works of the company in that and other cities.

MR. BAILEY WHIPPLE, recently connected with the Buckeye and Jandus Electric companies, of Cleveland, Ohio, is now associated with the Sawyer-Man Electric Company, with headquarters at the general offices and works of the company, West Twenty-third street, New York city.

MR. B. M. DRAKE, of the electrical house of Drake & Gorham, Limited, London, was a recent visitor to the United States investigating the latest development in the electrical field here. Mr. Drake's house represents a number of American electrical manufacturers and is arranging to increase its list.

MR. WALTER J. BRADY has assumed the office of superintendent of the North Jersey Street Railway Company's lines in Hudson County to succeed the late William W. McCormick. Although a strict disciplinarian, Mr. Brady is very popular with the men and his many friends are congratulating him on his well-earned promotion.